HANDBOOK
of
HEALTH AND NURSING

AMERICAN SCHOOL *of* HOME ECONOMICS
CHICAGO, ILLINOIS

HANDBOOK

OF

HEALTH AND NURSING

A COMPLETE HOME-STUDY COURSE

COMPRISING

HOUSEHOLD BACTERIOLOGY

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Household Bacteriology

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AMERICAN SCHOOL OF HOME ECONOMICS
CHICAGO

January 1,

My dear Madam:

In beginning our work in Household Bacteriology together I should like to make a few suggestions as to aims and methods of study.

The aims to be reached in the study of any science are at least two--a knowledge of its underlying principles and as thorough an application of those principles as is possible.

For the principles you will consult the lesson booklets. From them, too, you will get suggested applications, but the subject will not become a part of yourself until you recognize new applications many times a day. It is said that no person KNOWS a foreign language until he can think in that language. In a similar way you will want to think these facts into your life and work.

Suggestions for study have already been given to you. I hope that you may be able to try all of the experiments suggested; at least make a "dust garden" as described. If you can get no suitable dish, a regular Petri dish may be obtained through the School for 30 cents and a tube of prepared "nutrient gelatine" for 20 cents. The dish may be returned. Also, I hope that you will read some of the books recommended in the bibliography.

The facts of bacteriology underlie so firmly all our daily living that there is no need to go far afield for illustrations. But a thorough knowledge of the science can be gained only through laboratory methods and with a microscope. Therefore, I hope you may be able sometime to supple-

ment this study by microscopic work. Perhaps through the aid of some doctor or other scientist you may be able now to get a peep into this world of the unseen.

If these lessons point out dangers of which you were before unconscious, they also suggest ways of escape from those dangers. You will gain some knowledge of the causes of waste and disease If this leads you to efforts for the prevention and removal of such causes, the result will be those healthful conditions which make the most effectual safeguard against the attacks of the few micro-organisms that are our foes.

I hope the relations between hygiene and some of the daily tasks of housekeeping will gain a deeper significance in your mind; and this elementary study may result not only in pleasure and profit to you, but also, through you, in better conditions of healthful living for others.

Sincerely yours.

S. Maria Elliott

Instructor

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HOUSEHOLD BACTERIOLOGY

MOST persons now know that mankind is greatly troubled by the work of certain minute agents—variously termed germs, bacteria, micro-organisms. Few, however, realize the good that these forms do, or understand them and their place in the world. It is the purpose of the following pages to show the relations, both good and evil, that bacteria and other micro-organisms bear to the household.

DUST

Prevalence of Dust

Most housewives look upon dust as an undesirable thing that they are constantly seeking to be rid of. If dust is seen on the piano or on the table each thinks she will be considered a slack housekeeper. Perhaps some are not troubled by the presence of dust that does not show. Such fight the enemy vigorously where visible, but relax effort where or when he is invisible. The temptation comes to hide the tell-tale dust by shutting out light.

Few persons there are who have not at some time

exclaimed, "Where does all the dust come from?" If a house be thoroughly cleaned from cellar floor to attic ridge, tightly closed for months or years, when reopened dust will be found in great quantities.

This is true even in the country, where perhaps a single house, removed from the highway, stands surrounded by grass and trees.

The "housekeeping" of ships includes dusting. The officers' quarters of the government ships are dusted regularly, although land may not be seen for months at a time.

Dust-proof Room or House

Scientists have tried to get a dust-proof room or house in which to carry on their experiments. This has required attention to location and site, that there should be no jar from traffic or vibration from winds; a careful preparation of the surrounding soil; numerous walls separated from each other and made largely of glass, carefully joined and hermetically sealed. The air admitted must be freed from its dust; all clothes ordinarily worn by the experimenter must be exchanged for garments especially prepared and cared for, before he enters this to-be-dustless room. Even then all surfaces need to be slightly moist, that any stray speck of dust which has escaped all these guards may be caught and held.

Necessity of Dust

Such conditions as these can never be secured in ordinary life, so that dust will probably be present with us always. Indeed, it is probable that were all dust exterminated, life also would become extinct, for life in its most efficient forms needs light, and Tyndall

proved by delicate experiments that when all dust was removed from the track of a beam of light, there was darkness. So before the command, "Let there be light," the dust condition of light must have been present. Balloonists find that as they ascend higher the color of the sky deepens. At a distance of some miles the sky is nearly black, there is so little dust to scatter the rays of light. If the stellar spaces are dustless, they must be black, and therefore colorless. The moisture of the air collects about the dust-particles, giving us clouds, and with them all the glories of sunrise and sunset. Fogs, too, are considered to be masses of "water-dust," and ships far out at sea have had their sails colored by this dust while sailing through banks of fog.

Meteoric Dust

Astronomers find meteoric dust in the atmosphere. When this falls on the snow and ice fields of the Arctic regions it is readily recognized. The eruption of Krakatoa proved that volcanic dust is disseminated worldwide.

An old writer has said: "The sun discovers *atomes* though they be invisible by candle light, and makes them dance naked in his beams."

Source of Dust

Thus dust, just common every-day dust, is a very important and complex substance, which promises much of interest in its study. Therefore, again we ask where does it come from and of what is it made?

When a March wind blows over a sandy road or a November gale sweeps through city streets, it is evident that a large part of the dust found in the house

comes through open doors and windows. Few windows and doors are so tightly fitted that fine dust will not sift in round their casings.

Ingredients of Dust

Until electricity is made the common source of heat and light, there will be much dust from coal and wood, both before and after they are burned. These sources are too evident to need more than a mention. It is from the wear and tear of the house itself, its finish and furnishings, from our own bodies and the clothing that covers them, that the larger amount of dust comes. From these we have bits of wood, stone, cotton, hair, dead cells from all animal bodies—a mass of mineral, animal, and vegetable matter of very complex composition.

Since time began, everything in this old world has thus been wearing away more or less slowly, adding bit by bit to similar accumulations, until what we know as soil has been built up—pure mineral soil made from the debris of the rocks; organic soil or loam from the addition to this mineral soil of vegetable and animal debris. The same processes are continually going on all about us.

The dictionaries recognize this process when they tell us that dust is "Earth or other matter in fine dry particles so attenuated that they can be raised and carried by the wind."

Movements of Dust

Winds then are the responsible agents for much of the dust in our houses, but wind is simply air in motion. We cannot walk across the floor, make a bed, rock comfortably in a chair, or dance a jig without

making some wind currents. If dust is present in this current, it will be stirred up to settle back, where it was before, or to be blown to some other place. The more dust or the stronger the wind, the surer it is that the dust will be carried along with the current.

Why Keep Free From Dust

But why should the housewife spend so much energy and time in trying to keep her house free from dust? All the dust elements we have seen so far are not likely to do her much harm. The ashes or other mineral dust may scratch the polished table or the brass ornaments and silverware, but not so long as it lies quiet. It is the moving grain of sand, not the still one, that scratches. The other ingredients, bits of dead animal or vegetable matter, may be disagreeable to think of, but they are of the same stuff as ourselves, our clothes, our furniture. If this dead matter were all there is to dust, no one would ever have heard of the science of bacteriology.

Familiar Experiences

Many of the daily occurrences in the home give rise to questions which may be readily answered if we will but turn our kitchens into laboratories and try some simple experiments.

Perhaps you forgot to change the water in a vase of flowers and it stayed there a week. How did it smell when you poured it out? How did the stems that had been in the dirty water feel?

Possibly when you left home for a week's visit last summer, you knew the ice was all gone from the refrigerator, but you forgot to empty the pan underneath.

What did you find on your return? A slimy film over the surface of the water, did you not?

Such experiences may be familiar to all. A few years ago these changes were thought to be due to the oxygen of the air, which in some way, under certain conditions, made some things sour, some bitter, and others putrid.

Leavened Bread

In the days of our grandmothers much of the bread was made with leaven like that used in Bible times—a mixture of flour and water exposed to the air and whatever the air contained. This was called "barm." Such bread is still common in some parts of our country, and known as "salt-rising bread," and the barm when made with milk is called "milk emptins."

In the old days a portion of the leavened mass was kept to start the next batch of bread. Occasionally this was forgotten or it spoiled, then the housewife borrowed from her neighbor, as when the fire on the hearth was out, a coal was borrowed. Sometimes now the yeast raised sponge becomes slightly sour before it is ready for baking. Why?

Apple or other sauces containing sugar ferment or sour and the housewife scalds them. This may make them as palatable as when freshly stewed. Yet they often turn sour again and, after a while, scalding or even boiling does not remove the sharp or stinging effect upon the tongue.

Mold Mildew

The moist bread in the jar is found specked with mold; some August morning the sprinkled clothes

in the laundry basket are mildewed; the "best room," seldom used and darkened by drawn shades and tightly closed blinds, becomes musty.

What do all these things mean, or have they any relation to each other?

Experiments with Dust

We will now see if we can answer these questions.

Experiment I. Mix a little yeast with some sweetened water and let it stand in a warm place where the temperature is from 70° to 75° Fahr. Put a few tablespoonfuls of beef broth or molasses water into a cup or bottle and leave it uncovered in the kitchen where it will be warm. Watch carefully what happens. Before long bubbles show on the surface of the sweetened water; perhaps you may see bubbles rising in the broth. If left long enough the sweet liquid will be sour and the good broth smell bad. You say the one has fermented, the other is putrid. What has made the change? You did not add anything to the mixture; you only kept it warm and uncovered.

DUST GARDENS.

The Garden Plot

Experiment II. From any dealer in laboratory supplies or through the doctor or druggist get a Petri dish or plate. This is simply two round glass dishes, one-quarter to one-half inch in depth, one just large enough to fit over the other as a cover. See Fig. 1. This experiment can be made without the Petri dish, although not so conveniently, as follows:

Take a clear glass sauce dish or a finger bowl. Fig. 2. Cover with a piece of smooth, thin glass clear

enough to see through readily and large enough to entirely and tightly cover the dish. After washing well, place both together in a pan in a cool oven and gradually raise the temperature until it is hot enough to bake bread or to yellow a piece of white paper in half a minute. Let them bake for an hour or more. Then open the oven and place the pan where the dish may cool slowly. When cold take out, without removing the covering plate, and put round both dish and plate a strong rubber band, or tie them together with a string.

This we will call our garden-plot. But a garden is of little use without something growing in it, and for this soil is required.

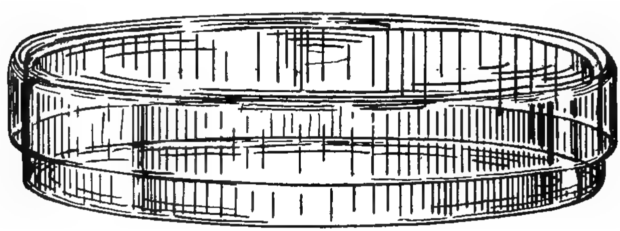


FIG 1. PETRI DISH FOR PLATE CULTURES.

Soil for the Dust-Gardens

For the soil take the following recipe: Chop finely one-quarter pound of lean, juicy beef. Mix this with one cup of warm water. Heat in double boiler, stirring often until water in water pan has boiled fifteen minutes. Remove inner dish, place directly over the fire and allow broth to boil ten or fifteen minutes. Clear by straining through two or more thicknesses of

flannel wet in cold water. Squeeze the meat carefully to get out all its juices but not much fat. The meat is acid, therefore, add from one-eighth to one-quarter teaspoonful of bi-carbonate of soda. Replace the water lost through evaporation.

Preparing the Soil.

Moisten three heaping tablespoonfuls of finely divided gelatine in a very little cold water and add to

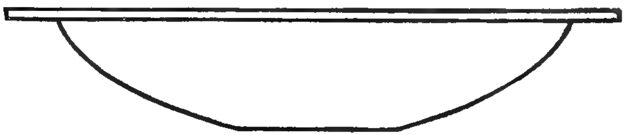


FIG. 2. SHALLOW BOWL COVERED WITH SHEET OF GLASS.

the boiling hot broth. When the gelatine is dissolved, strain through hot flannel.

Put three or four tablespoonfuls of the broth into each of several small bottles. Plug the mouth of each with a close wad of cotton wool or tie over each a thick mat of the same. For three successive days place the bottles on a piece of folded cloth in a pan of cold water and boil them fifteen minutes.

Gelatine melts at quite a low temperature, so if the dust garden is prepared in summer it may not remain solid. If kept in a very warm place in the room it may melt at any time. A better substance to use for the jelly is *agar,* which remains solid at blood heat, 98.5° Fahr. This may be found in some cities at the druggists', or at the dealers in chemical or bacteriological supplies. It solidifies suddenly, if its temperture drops below a certain point, and as it is rather

difficult to prepare, the gelatine is more favorable for the amateur's use.*

In our garden we want only certain kinds of plants, and we want to know just where they come from, we,

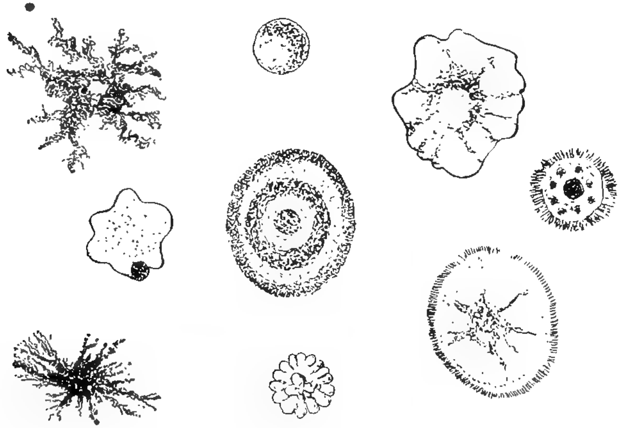


FIG. 3. COLONIES OF DUST-PLANTS, GROWN ON GELATINE. (After Conn.†)

therefore, bake the dish and boil the jelly until sure that nothing in either is alive.

Planting the Garden

When ready to plant the garden, put the bottle of jellied beef juice into a dish of cold water. Heat this until the jelly is melted and then cool slightly.

*For the careful, accurate preparation of such soil, consult "Laboratory Work in Bacteriology," Frederick G. Novy, or any other manual of laboratory practice in Bacteriology.

A Petri dish may be obtained from the School for 30c and a bottle of *agar* ready for use for 24c (in stamps) sent postpaid.

†The "Story of Germ Life," H. W. Conn; D. Appleton & Co., Publishers.

Remove the elastic from the dish. When the tube or bottle of jelly is cool enough to be held in the hand, remove the cotton wool plug or stopper, carefully raise the cover of the dish on one side, just enough to insert the mouth of the bottle. Pour the melted jelly into the dish, cover, and gently turn with a circular motion until the jelly is spread evenly over the bottom of the dish. Replace the elastic and let the jelly harden.

The garden is now ready for planting. To do this, all that is necessary is to remove the cover and leave the dish open for from twenty to thirty minutes. If opened in a very dusty place, expose only ten minutes. Do not go near or meddle in any way. At the end of the time replace the cover and the elastic band. Let the dish remain in a warm room not above 70° F, and watch carefully for whatever happens.

Growth of the Garden

In the course of thirty-six to forty-eight hours or longer, minute light-colored specks will show on the surface of the jelly. These will be seen to grow larger, to become of different colors—pink, yellow, orange, green, blue, possibly a deep red.

Some spots will be shiny, smooth, and round; others branched like mosses or seaweeds; others with white rims and dark centers, showing a pile like velvet, and, when seen through the sides of the dish, they may suggest minute pins with ball heads. Fig. 3. All of these forms may not show themselves, but in most cases there will be seen the shiny, smooth spots,

and the hairy or velvety ones. Look at the garden through a magnifying glass, if possible; watch every change; write down an accurate and full account as to time, appearance, conditions of temperature, light, etc. Then change the conditions. Put the dust-garden into the refrigerator, shut it into a box, etc. See how the colonies are affected by each new condition or by any two combined.

If a compound miscroscope can be used, touch the point of a needle to one of the spots and place the speck of matter taken up on a clean glass slide. Put on a drop of cool boiled water, and over this a cover glass; examine carefully for shape and motion; draw what is seen. In this way examine the different colonies to see if the forms in all are of the same shape.

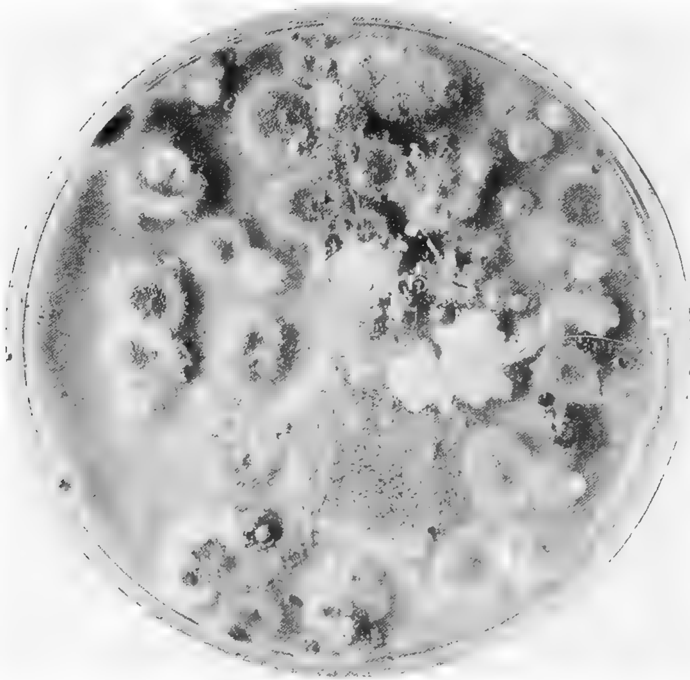
Putrefaction

Let the dust garden grow for a week or more, then gently raise the cover, smelling of the contents, and as this is done, if the growth is sufficiently far advanced, there will be sensible proof that dust-plants may cause putrefaction. The next time you are tempted to leave a piece of meat exposed, remember the dust-garden, and cover the meat with a cloth to keep out dust.

Figures 4 and 5 are photographs of such dust-gardens after more than two weeks' growth. The principal colonies of molds are marked *a*, and those marked *b* are colonies of bacteria. In Fig. 5 the row of colonies marked *b'* shows well how thickly they

FIG. 4. PHOTOGRAPH OF A DUST GARDEN AFTER TWO WEEKS GROWTH.

Colonies of Mould Marked *a*; Colonies of Bacteria not Marked.



"DUST GARDEN" SHOWING ABUNDANT GROWTH OF MOLDS

Made by a Member of the A. S. H. E.

sometimes crowd together. Probably these were all attached to some tiny fibre of wood or cloth.

Kinds of Soil

The soil or "nutrient gelatine" in our experiments had beef juice in it; you will ask if any other soil would do. The gardener knows that his pinks will grow better in one place and his ferns in another because each requires or likes, we may say, a particular kind of food which that soil contains.

In the laboratory numerous soils or nutrient media are used—milk, potato, beer, blood-serum, etc.

A moment's thought will show that all the food substances which we like best are subject to changes which in general we designate as "spoiling." Some grow bitter, some sour, some odorous, some rancid. In a few cases this result is due to processes brought about by mere chemical changes—that is, without the intervention of any living agent or ferment; but in most cases where food spoils, it is due to the growth on or in the substance itself of the little plants, which have been carried to it through *ordinary dust.*

Souring of Milk

The milk in the pantry is found to be sour. When it was secreted by the milk gland in the cow's body it was sweet and pure. It passed down into the milk duct in its passage outward, and here perhaps it met a few of the dust-plants which had passed into the mouth of the duct from the outside. Hundreds, no doubt, fell into the pail from the dusty air of the stall the cow's hairy coat, the milkman's clothes, or hands, or hair, even from the pail itself, for all are more

or less dusty. Among these hundreds of forms are some that like the sugar of the milk as food. While feeding upon this, they change a part of it into acid-lactic acid. When this acid reaches a certain amount, it coagulates the casein of the milk.

Production of Lactic Acid

The cleaner the milk, the fewer of these lactic acid producing plants will be present and the longer the milk will keep sweet. Cold retards their growth. Milk should then be cooled as quickly as possible after being drawn from the cow, and should be kept in a cold place at all times.

Milk is a most favorable culture ground for bacteria because it has some of all classes of food elements, being what is known as a perfect food. Its opaqueness hides much of the solid dirt which not only seeds it with bacteria but adds certain soluble matters. Too often the dirty character of the milk is known only by sight of the actual dirt at the bottom of the empty glass.

The possibilities in the way of *clean* milk, which means *safe* milk, were forcibly illustrated by exhibits from some American "model dairies" at the Paris Exposition in 1904. Milk and cream in a perfectly fresh condition were shown after a journey of ten days; the only treatment being extreme cleanliness in milking, stable, receptacle, etc., and *cold*. A glass of ordinary, unclean milk contains millions of bacteria, which although harmless to a vigorous adult are the cause, direct or indirect, of the death of thousands of young children annually.

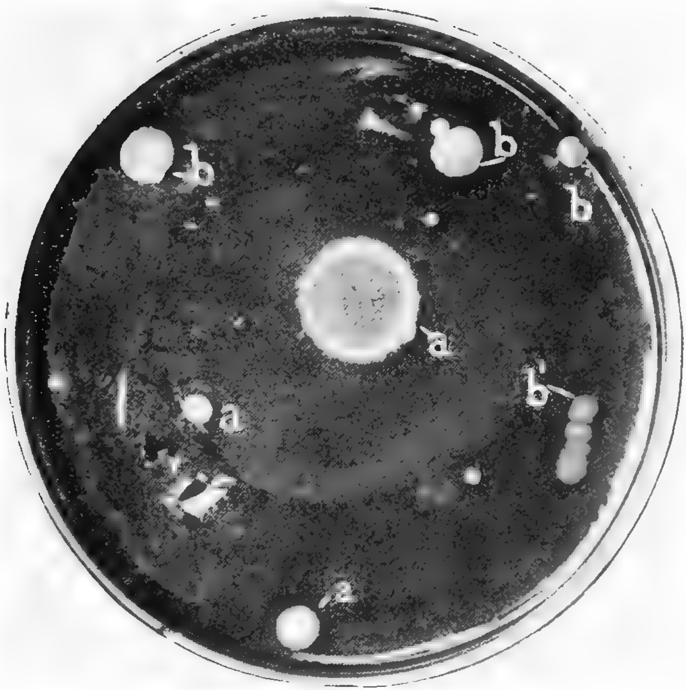


FIG. 5. A DUST GARDEN.

(a) Colonies of Mould. (b) Colonies of Bacteria.

(b′) Colonies of Bacteria on a Thread.

DUST PLANTS

We have seen from the dust-garden that dust does contain living plants which, when they find food in a moist, warm place, will grow and multiply.

Colony of Dust Plants

They were not seen when they settled out of the dust on the jelly, and not until they had reproduced

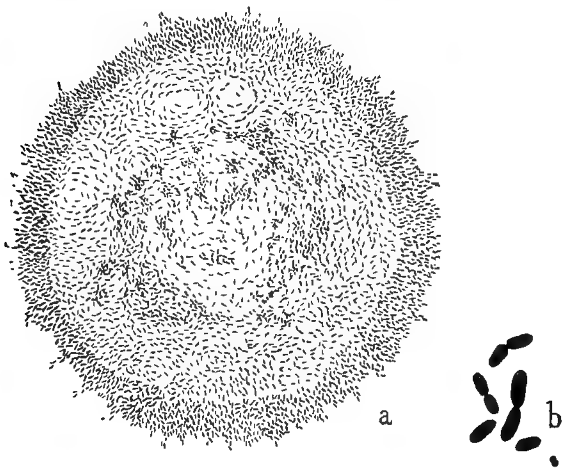


Fig. 6. (a) One Colony of Bacilli or Rod-Shaped Bacteria as Seen in "Dust Garden." Highly Magnified.
(b) Eight Bacteria from the Colony, Magnified Much More.
(After Prudden.)

themselves many times, so that a "colony" was formed, were we able to see that anything had been planted in the dust garden. But each colony or spot shows where a single plant dropped on the gelatine; the spot becomes visible only after it contains thousands of individuals, which are kept close together by the gelatine.

Names of Dust Plants

All of these dust-plants have to be studied under the microscope and are therefore called *micro*-organisms. *Microbe*—a name given by Louis Pasteur—which from its derivation would include all, has come gradually to be applied to one class, the bacteria. Still a third word, *germ*, which really means the beginning, or that first living cell which produces a more complex form, is becoming restricted to the micro-organisms that cause disease, as the germ of tuberculosis, the germ of typhoid fever, etc. All these names may apply to microscopic animal forms as well. Strictly speaking, all dust-plants are germs, all are microbes, all are micro-organisms.

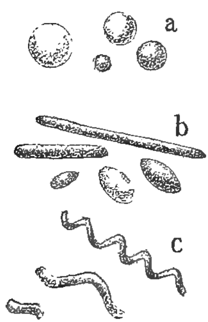


Fig. 7. Typical Forms of Bacteria. (a) Cocci, or Ball Forms. (b) Bacilli, or Rod-shaped Forms. (c) Spirilla, or Spiral Forms.

The "garden" will show two kinds of plants and sometimes a third, although this is not so common in house dust. We will now see what these three kinds of plants are, two of which we may expect to find in all houses at any time. The third, wild yeast, would very likely be caught if we planted our dust garden under the apple trees in summer time.

BACTERIA

Let us find out first what the plants are like which make the smooth, glossy, shiny colonies, whether round or radiate. These are the *bacteria*, and each colony

has come from the reproduction of one parent—a bacterium. Fig. 6.

Shape of Bacteria

Under the microscope these bacteria show three principal shapes. Fig. 7. One like a short, round stick or rod, is called a *bacillus* and *bacilli* for the plural. Fig. 7b. Another is ball-shaped, called *coccus* or *cocci* for the plural (the third *c* sounding like *s*). Fig. 7a. A third form which resembles one turn or more of a screw is called a *spirillum* or *spirilla* for the plural. Fig. 7c.

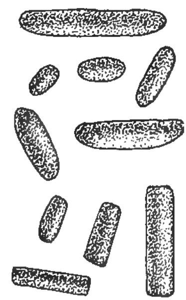


Fig. 8. Bacilli or Rod-shaped Bacteria.

These typical forms may shade into each other. The bacilli may be long or short, with pointed, blunt, or square cut ends. They may be so short and plump as to closely resemble a coccus. Fig. 8. The spiral forms may curve very little or have decided and numerous twists. Fig. 9.

Bacteriologists do not always agree as to which class a newly found individual should belong, and to the housewife it makes no difference.

Structure of Bacteria

The bacteria are so simple in structure and so difficult to study that there is little to describe. Each consists of a single cell, so far as is known. This seems to have a denser portion on the outside, which forms a cell wall and may be cellulose as in the higher plants.

This simple cell of protoplasm or "foundation stuff"

is endowed with all the characteristics of living matter anywhere.

Excretions of Bacteria

All living things whether plant or animal take food in some way. All, too, having taken food, change it over into their own substance and give out

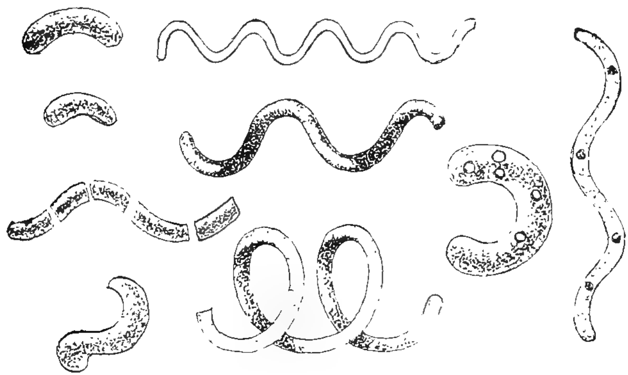


FIG. 9. DIFFERENT FORMS OF SPIRILLA.

some of the results of these changes as waste products in the form of gases, liquids, or solids.

Bacteria are no exception to this universal rule. Their products are either gases or liquids and these, dissolved in blood or other liquids, bring about various changes, the results of which may be either desirable or undesirable, according to the nature of the bacterium, the amount of the excretion, or other conditions under which the changes are wrought.

The processes of bacterial growth in the human body and in food substances are similar.

The excretions of the bacteria in milk, fish, etc., may produce changes which, very apparently, render them unfit for food, or the changes may not be apparent. If food containing these excretions be eaten, or if the bacteria grow in the body itself, the excretions may bring about abnormal conditions more or less severe, but all may be called disease.

Like the maggots in cheese or the clothes moth larva, the bacteria live surrounded by their food supply and they have only to take, digest, and absorb it as needed. Like these animal forms, they feed upon complex organized food which has been previously prepared by other plants or animals. In this they differ from most plants which must manufacture their food out of the mineral and other inorganic substances in air, water, or soil. However, some species can do this although they have not the green coloring matter or chlorophyll cells which in the higher plants are the food factories.

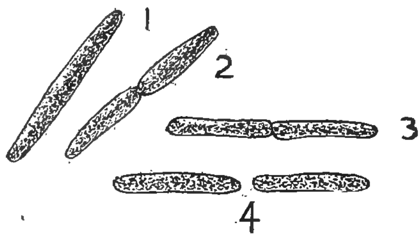


FIG. 10. A BACILLUS DIVIDING INTO TWO GENERATIONS.

Bacteria are Plants

Because of this power of living on inorganic substances, which no known animal possesses, the scientists have decided that these micro-organisms must be called plants rather than animals.

Bacteria have no leaves, roots, stems, or any or-

gans like higher plants. They are simply transparent bits of jelly-like protoplasm.

Food of Bacteria

Bacteria in general like the same kinds of food that man likes, although they do not require the variety in diet which to civilized man seems necessary. Some flourish best in meat juices, others in milk, some in starchy foods, others in sugary solutions, while still others enjoy best the fats.

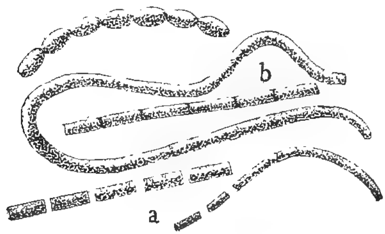


Fig. 11. Different Forms of Bacilli.
(a) Simple, detached forms.
(b) Chains of united bacilli.

They also show, like man, a surprising faculty of adaptation. If unable to get their favorite food, many will grow on whatever is at hand. Any organic substance which is not absolutely dry may become food for some species of dust-plants. Dust-plants will not leave the moist surfaces upon which they fall, but where such surfaces become dry, then the plants are ready to be blown into the air by winds or carried along on anything which touches them.

Ordinarily dust particles are probably never so dry that the bacteria or other micro-organisms clinging to them are killed.

Reproduction of Bacteria

All bacteria reproduce by division of the parent into halves, which process is called fission. Fig. 10. Sometimes these daughter cells remain attached even after they themselves have divided into two. A

chain of cells results so that what looks under the microscope like one individual may be three or more generations. Fig. 11.

The ball forms divide in the same way along a diameter. Some, however, divide in more than one di-

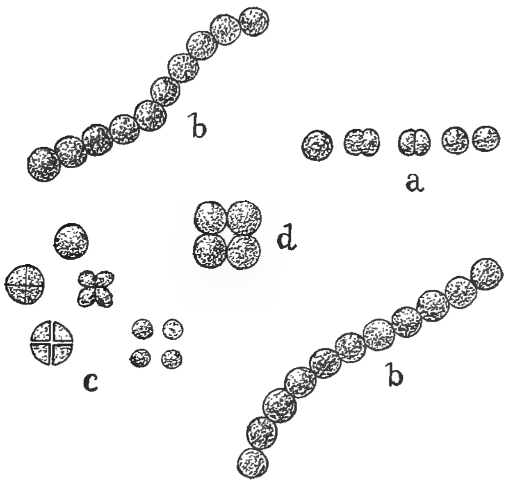


FIG. 12. REPRODUCTION OF COCCI BY FISSION.
(a) Division into two. (b) Chains of cocci. (c) Division into four. (d) A sheet of four cocci.

rection, so that the colony of daughter cells may touch at one side only, like closely strung beads, or on two sides, making a sheet or film of cells, or they may become piled upon each other like a cube of marbles. Fig. 12.

The spiral forms also may remain in one colony or break up into single cells after division.

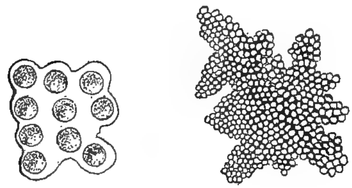


FIG. 13. ZOOGLOEA OR THE FILM-FORMING BACTERIA.

Sometimes they unite their bodies by a gelatinous film to form a slime over the surface of whatever they are growing upon, as seen on the walls of the waste pipe of the refrigerator or on the surface of the water in the pan. This is known as a zoogloea form. Fig. 13.

Rapidity of Growth

The rapidity with which they reproduce depends largely upon the food supply, the warmth and moisture—that is, whether the conditions of life and growth are favorable.

In this prolific reproduction lies their great power for harm or benefit to the world.

In some species, under favorable conditions, a new generation is born oftener than every half hour. If this rate were continued for a day, one bacterium might become ancestor of over sixteen million descendants. Some interested observer has calculated that in two days the billions thus born would fill a pint measure and weigh a pound, while in another twenty-four hours their weight would equal eight thousand tons.

These numbers, however, are of no practical im-

portance, for long before such a population was reached the food supply would be gone or the parent forms would be killed by their own excretions. Here, as in the animal world, if the wastes of living accumulate, death results. Yet wherever conditions of moisture, warmth, and food remain favorable they will multiply with almost infinite rapidity.

Bacteria Are Classed as Fungi

Botanically the bacteria belong to the fungi, and because they reproduce by fission or breaking into two, they are called Schizomycetes or Fission Fungi.

A string of sausages, often seen hanging in the windows of a market, is a fair representation, except in size, of a chain colony of bacteria.

Take a piece of white rubber tubing, ten to twelve inches long and from one-half to one inch in diameter. Tie it tightly at one end with waxed thread. Fill this about three-quarters full of water and tie the second end so that no water may escape. From thread to thread will represent very well a bacillus.

Divide this in the middle by a rubber band and two generations are represented or a chain colony of two individuals. The same method may be continued to show the future reproduction processes.

Size of Bacteria

Their minute size would seem to indicate insignificance, but they make up in energy, in the work done, and in numbers, for all that is lacking in size. Not one is ever visible to the naked eye, while some can be seen only with great difficulty by the skilled observer and under the most powerful microscope.

They are so small that little idea of their size can

be obtained by actual measurement, only by comparison. Fig. 14 represents the largest bacterium known magnified six hundred diameters. One twenty-five thousandth of an inch is not an uncommon length for a bacterium.

Yet, small as they are, they are heavier than air, and therefore settle out of it when it is still.

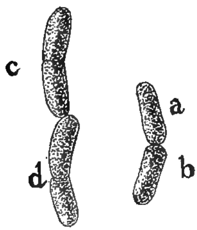


Fig. 14. Bacillus Megatherium.
(a and b) Individuals.
(c and d) Two individuals, each dividing into halves.

It is estimated that in the space occupied by a grain of sugar there might be packed six hundred millions and each bacterium be comfortable. Compared with the bacteria which may lodge there, the wrinkles in the skin of our hands are like ditches six or eight feet deep. No wonder that it is difficult to dislodge them by any ordinary washing. The surgeon has to resort to a strong soap, vigorous brushing, and the use of numerous bacterial poisons in addition to the ordinary washing, before he is sure that these valleys are not rich in the tiny plants that might bring suffering or death to his patient.

Relations to Oxygen

Most of the bacteria require oxygen to breathe, as we do, but some can live without air. Some will accommodate themselves to any condition. Preferring much or little oxygen, they will, however, grow under the opposite condition, if they must.

Disease and Darkness

Of course, the disease germs which grow in the interior of our bodies flourish best under conditions of darkness and lessened air supply. Out-of-door life, then, is a preventive measure, and next to this is a

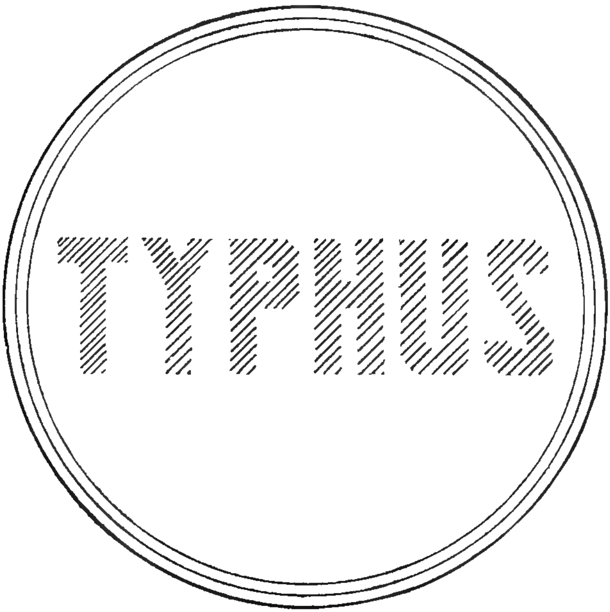


FIG. 15. SUNSHINE AS A DISINFECTANT. (After Lefar.)
Under the letters of black paper there was growth; in the remainder of the plate the sunlight killed the bacteria.

generous supply of sunlight and fresh air inside our houses.

Experiments have shown that the disease germs

live much longer when grown in a cellar than when cultivated in the light rooms of a house.

Effect of Sunlight

All disease germs, so far as known, are *killed by direct sunlight.* This was proved some years ago by planting a Petri dish with typhoid fever germs. Half of the dish was covered with black paper, while the uncovered half was exposed to direct sunlight. On the sunlighted half no growth appeared, while the other half showed many colonies. A similar experiment is illustrated by Fig. 15.

In this experiment the letters of the name "Typhus" were cut out of black paper and placed on the under side of the cover of a Petri dish which had been planted with bacteria. The dish was exposed to sunlight for an hour and a half and then left in a dark room for twenty-four hours. When the paper letters were removed, the space covered by them was found thickly studded with the minute colonies of bacteria. The rest of the plate showed no appearance of bacterial life.

Power of Movement

Some bacteria, like most of the higher plants, remain stationary, having no power of motion, while others move by slow or jerky, worm-like contractions. Still others are moved about by whip-like extensions of their bodies, called flagella or cilia. Some have only one whip at one end of the body, others one or a cluster at each end, while others have them reaching out from all parts. Fig. 16.

Some bacteriologists place all the forms which have

flagella in one species—*Bacillus,* and all without flagella in another species—*Bacterium.*

When for any reason there comes a period of hard times in the life history of the bacteria, such as cold, dryness, or lack of food, some bacteria have the **Spores**

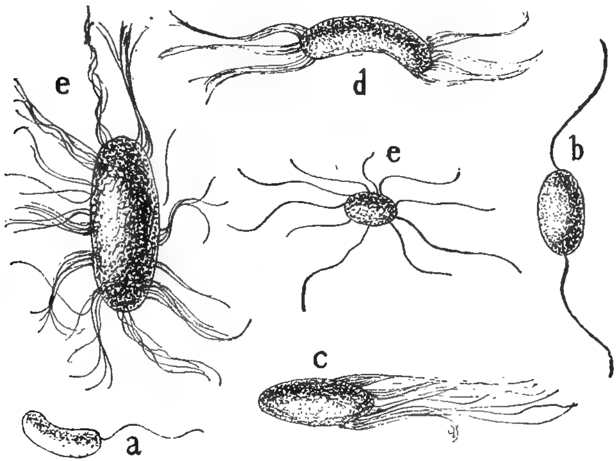


FIG. 16. BACTERIA WITH FLAGELLA.
(a) A flagellum at one end.
(b) A flagellum at each end.
(c, d, and e) Tufts of flagella in different positions.
(After Conn.)

power of contracting their bodies into smaller space, possibly drawing it all into one end or from the middle into each end. Fig. 17. This is called the *spore stage.* These spores can weather great extremes of famine or cold or resist the action of strong chemicals. Some can be frozen, others boiled and still retain life. When good times return in the form of

moisture, warmth, or more food, the resting, resistant spore starts into growth again and continues its life as before.

Resistance of Spores

The species that do not form spores are much more easily killed. Those that form spores readily, being difficult to kill, are more likely to cause disease or destruction of property. Fortunately for us, most of the disease or "pathogenic" germs do not form spores readily, if at all. It is these spores that make necessary the *repeated* "scalding" by which the housewife tries to save the food which she finds spoiling.

The lowest temperature known will not kill some bacteria, while some varieties in the *spore state* will resist the temperature of boiling water. Indeed the heating sometimes seems to favor their changing into the active state.

Dust Plants in the Refrigerator

Dust readily finds access to the ice box or the refrigerator, even if the ice is thoroughly cleaned before it is put in. The dust-plants will grow on any bits of food carelessly dropped and by their gaseous products may taint the meat, milk, and other foods. The escape pipe of a refrigerator needs to be often and carefully cleaned throughout its entire length, else it will be covered with a slimy mass of bacterial growth. Many of the bacteria found here are the germs of putrefaction.

This pipe may be cleaned with a swab of cloth or sponge tightly wrapped around a long stick, rattan or whalebone, with a small, long-handled brush,

or if the pipe is too difficult of access for these methods, a boiling hot solution of washing soda may be poured down once a week, or when the ice box is empty.

The pan under the refrigerator should be scrubbed carefully with hot soapsuds or scalded with the wash-

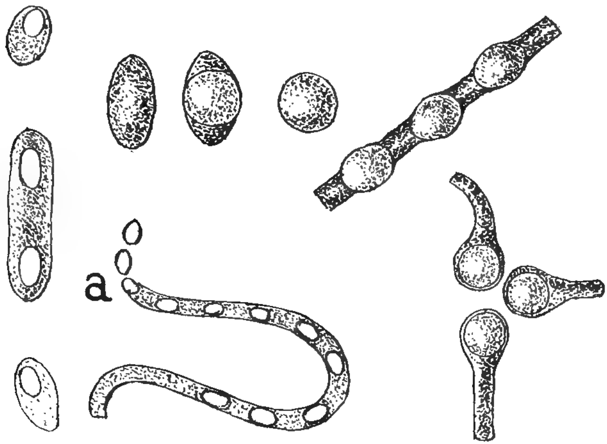


FIG. 17. VARIOUS SPORE BEARING BACTERIA.
(a) Spores Escaping from Ruptured End. (After Conn.)

ing soda, that no slime may appear. The escape pipe, too, should be opened to the air and in a place where the air will be pure.

The housewife who allows her refrigerator pipe to empty directly into a hole in the cellar floor, underneath which is a slimy mass of muddy filth, need not be surprised that milk and butter do not "keep well."

Boiling Clothes

The greatest argument in favor of boiling clothes in the laundry is based on the bacteriological reason. Body clothes, bedding, towels and handkerchiefs may all become soiled with discharges of the mucous membranes of the body or from some wound or pus formation. In most of these discharges there is sure to be bacteria. Soap has a slight disinfecting power, but the boiling is far more efficacious. Scalding or the pouring of boiling water over the clothes is not sufficient for disinfection, for only the top surface is subjected to the high degree of heat necessary to kill the germs. Soap or other alkali, boiling, fresh air, and sunshine are a sanitary quartet whose work results in sterilization—that is, in death to the germs.

Natural Home of Bacteria

The natural home of the bacteria is *the soil*. Here they are most numerous because here they have their greatest field of work laid out for them, which is to change any dead vegetable and animal matter that may be present into inorganic substances which can do no harm to life.

When winds blow over the soil they raise the dry dust particles laden with bacteria into the air; rain washes millions of them from the air and soil into the brooks and rivers; therefore, all surface waters are seeded with bacteria.

From the soil they may be directly brought into the house on shoes, or clothes, or hands; indirectly through dusty air.

The cleaning of shoes on a mat, brush, or scraper

outside the front door is a habit to which all children should be trained. Adults should think what it means to bring street filth into the dry, warm house. If all coats, dresses, etc., worn on the street could be brushed out of doors still another fruitful source of dangerous dust would be avoided. House air is found to contain thousands of bacteria, where out-of-door air may have only hundreds, because moist surfaces catch and hold them. Sunlight and large amounts of fresh air tend to kill them. The house has less fresh air, less sunshine, and it is filled more or less with dry, rough furnishings, which add to the dust and all tend to hinder its removal and to lessen the chances of disinfection.

Laboratory Study

In the laboratory bacteria are studied in many ways. Under the microscope is noted their shape and size; what kind, and the rapidity of motion, if any; how they tend to arrange themselves upon division; whether spores are formed or not.

From plate and other cultures can be seen the shape and color of the colony; whether they grow best on the surface, in much air, or below the surface where air is excluded; whether the temperature of the room is more favorable than that of the incubator, which is much higher and represents more nearly the conditions inside of our bodies.

Secretions

Some of the bacteria secrete an acid which liquefies the gelatine on which they may be growing. This acidity can be detected by litmus paper. Some produce a gas when grown in a sugary solution, others

cause putrefaction. Each of these differences means much to the trained observer, for from such results has been and must be gathered our knowledge of their probable behavior outside of the laboratory.

Importance of Bacteriology

In the bacteriological laboratory has been found out facts which in the commercial life of the world mean millions of dollars; there, too, have been started experiments which have led to incalculable saving of human suffering and life, through sanitation, preventive medicine, and surgery.

Here we see how the little things of life have confounded the mighty and how "the science of the infinitely small," by which some one has defined bacteriology, "has become the infinitely important."

MOLDS

Growth of Mold

Another micro-organism which is seldom absent from house dust, either as the plant cell itself or its spore, is mold. This in our dust garden formed the colonies with dark centers and a velvety pile. Molds

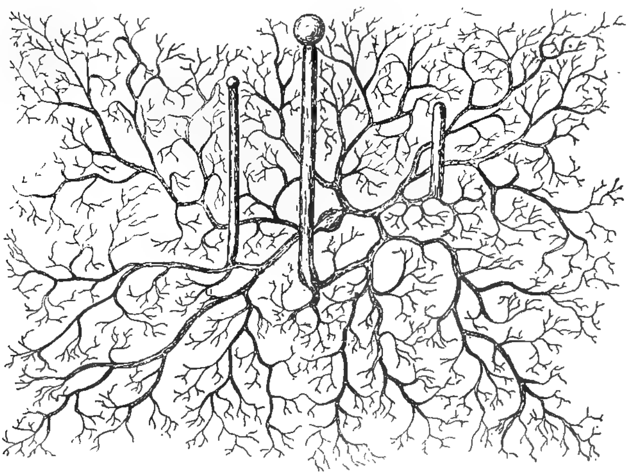


FIG. 18. A GROWTH OF MOLD.
Mycelium, Hyphae and Spore-cases. (After Jorgensen.)

consist of vegetative portions which grow out in long threads, and these by budding and branching unite to form a network over the substance they are using as food. Fig. 18.

Reproduction

From this network or *mycelium* grow out cells called *hyhae* set apart for special work—that of bearing the reproductive portion—the heads or stalked clubs. Inside these heads or from their outer surface

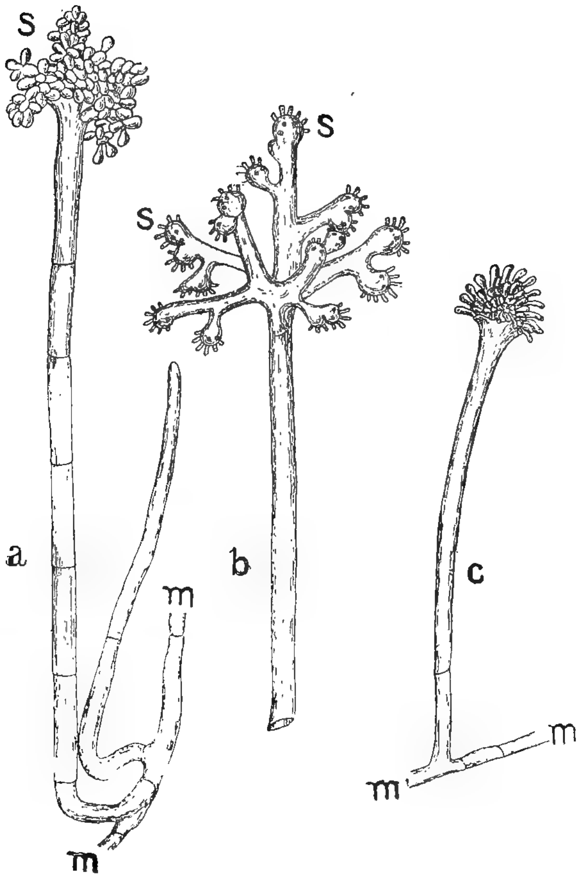


FIG. 19. MOLDS SHOWING A MYCELIUM BRANCH, (m.)
(a) With ripe spores (s).
(b) A spore-bearing stalk with spores just forming.
(c) Spores have fallen. (After Jorgensen.)

Mold Spores

grow the spores which are to reproduce the species. Figs. 19 and 20. Each head produces thousands of dust-like spores. Fig. 21. This is the common method of reproduction in the molds, although some, like the bacteria below them in the scale of nature, break the parent cell into segments, while others send off buds like yeast. These buds form directly the second generation.

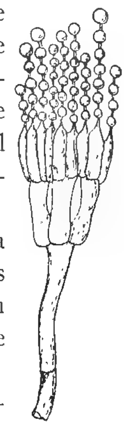


FIG. 20.

When the invisible spore falls upon a moist, warm surface, it immediately begins to grow by sending out the mycelium branches, which will then proceed as before to develop more spore-bearing cells.

Sometimes these mycelium cells penetrate into the food substance, very much like the roots of the higher plants.

One of the effects of mold growth is seen in the softening of cellulose in fruits, vegetables, etc. This makes their decomposition by the bacteria more speedy and thorough. Out-of-doors this action is of great use in the economy of Nature, but inside our houses the presence and growth of molds should be guarded against in every way.

In general, molds will grow with less moisture than bacteria, and some of them flourish in the light. They increase rapidly after rainstorms and are much less affected than the bacteria by winds. They need organized food, as we well know from the places where we find them growing—bread, meat, leather, sugary liquids, or even in vinegar.

Work of Molds

In general, they form fewer desirable products than do the bacteria, although this may be considered a matter of taste. Those who like Limburger and Brie cheese; the Chinese "soy," which is made from a kind of bean on which mold has grown; the Japanese "sake" or rice wine, which has been fermented by molds—these persons certainly would claim that molds were as valuable in the production

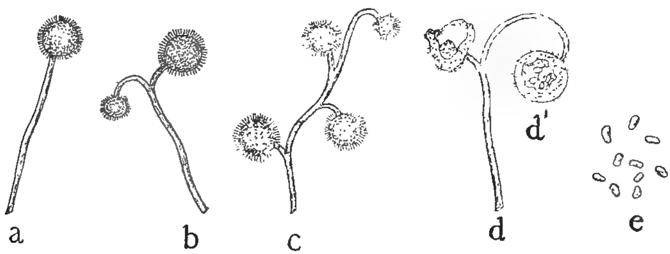


FIG. 21. DIFFERENT STAGES IN THE DEVELOPMENT OF MOLD.
(a, b, c and d) Growth of the spore-cases.
(d') The spore-cases open.
(e) Spores. (After Jorgensen.)

of flavor as the bacteria are in butter and ordinary cheese.

Just what their action is upon digestion is not definitely understood. It is thought that many of them cause a lax condition in the bowels, possibly diarrhœa.

Disease from Molds

They are found to cause various diseased conditions of the skin—*Ringworm*, *Thrush*, and *Moth*. The moth patches, often called *Liver spots*, because believed to be due to an inactive liver, are found to be caused by mold spores which have gained access to

the body tissues through some break in the skin. Fairly strong acetic acid—40 per cent—is one of the best remedies for moth.

They sometimes penetrate quite deeply into the tissues, causing irritation, inflammation, or sores very difficult to heal because there can be no healing until the plant is killed.

Food fully penetrated by mold growth would better be destroyed. When the growth occurs only on the surface, as on jelly, olives, pickles, etc., the mat of cells protects the food beneath and most of it is unharmed. Such foods, however, are often softened by the products of mold and bacterial growth, when no sign of mold appears on the fruit itself. If eaten, various intestinal disorders are liable to occur.

Mildew

Moist cloth furnishes favorable soil for mold when warm and not open to fresh air. The folded garments laid away gather moisture; dust containing mold spores is usually present on them, and in time, soon or late, the garments grow musty even if there be no visible mold. *Mustiness* is the proof of mold, and mold the proof of dampness and dust. We call the mold growing on the cloth mildew, but called by either name it is the same dust-plant. The plant must be killed to stop its growth. If it has grown only on the surface of the fibre, the stain may sometimes be removed without serious injury. If it is of long growth or has penetrated the fibre, a hole will result, because of the weakened or actually destroyed fibre.

So far as the healthful house is concerned, there

need be no separation in the mind between molds and bacteria, because the occurrence and conditions of growth of both are practically alike. So far as is known, there are no molds that cause such serious and fatal diseases as some of those caused by bacteria.

Because molds are lighter than the bacteria, it takes much longer for them to settle. The air, then, is likely to contain molds even where it has been quiet so long that the bacteria have all settled. This gives the housewife another reason for the economy of keeping the air of her kitchen, pantries, or any place where food is prepared or stored, as free from dust and as dry as possible.

Moldy Houses In old houses it is sometimes impossible to keep food in certain closets or cupboards. The woodwork or plaster and therefore the air is so charged with mold spores that one damp day or the presence of warm, moist food alone will cause them to spring into growth. Such places should be often whitewashed and painted or disinfected.

The spores of molds are often very beautiful in color when seen in mass, and under the microscope they show exquisite forms and delicate ornament. These factors, as well as the substances upon which the mold grows, are used as means of distinguishing species.

The botany of molds is to many as interesting a study as that of the higher plants. Only a microscope can bring out the beauties of this class of dust-plants, which from the standpoint of economy and health the housewife can view with disfavor second

only to that she bears for some of the bacteria. So many more of the bacteria are friends rather than foes that it may be more just to place mold as her chief enemy.

YEAST

Size and Structure of Yeast

The third variety of plants found in dust is yeast. These are not usually so numerous as either the bacteria or the molds, although about apple trees in the country wild yeasts are common. Like a bacterium, the yeast plant is a single microscopic cell of protoplasm enclosed by the cell wall. It is round or oval in shape and often one two-thousandth of an inch in diameter. Fig. 22. It is therefore quite a giant compared with the smallest bacterium.

If a drop of tepid water in which bread yeast has been dissolved be carefully watched under the microscope, the changes shown in Figs. 23 and 24 may be seen. One cell will be seen to swell a little at one part. This bud or daughter cell will bulge out more and more from the parent and may even produce one or more generations from itself before it breaks away. This "budding" is the method of reproduction common to yeast plants of which there are many varieties.

Spores

Some species, however, reproduce by spores very much like the molds. Such yeast cells will be seen to divide within the cell wall into two or four rounded bodies which in growing soon rupture the parent cell and escape. Fig. 25. Each of these liberated spores forms a new plant which may produce buds.

Thus the generations are continued and the individuals multiplied.

Requirements for Growth

Yeast requires food, oxygen, warmth, and moisture. Sugary substances are especially liked by the yeast which is used to make bread. This is a specially cultivated form of brewer's yeast. Yeast directly from

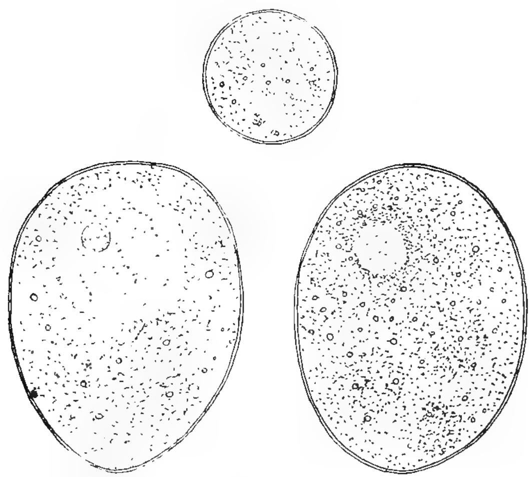


FIG. 22. TYPICAL FORMS AND APPEARANCE OF BREWERS' YEAST. (After Sedgwick and Wilson.)

the breweries is often used for breadmaking. It is while feeding upon these sugary solutions that the tiny plants bring about the chemical changes by

Products of Growth

which alcohol and the gas, carbon dioxide, are produced. The gas puffs up the dough and makes pos-

sible the raised bread, or the "election cake" like that of our grandmother's time; it also produces the "froth" and "sparkle" of the "home-made spruce beer" as well as that of the large breweries.

Yeast plants grow best from 70° F. to 90° F. They

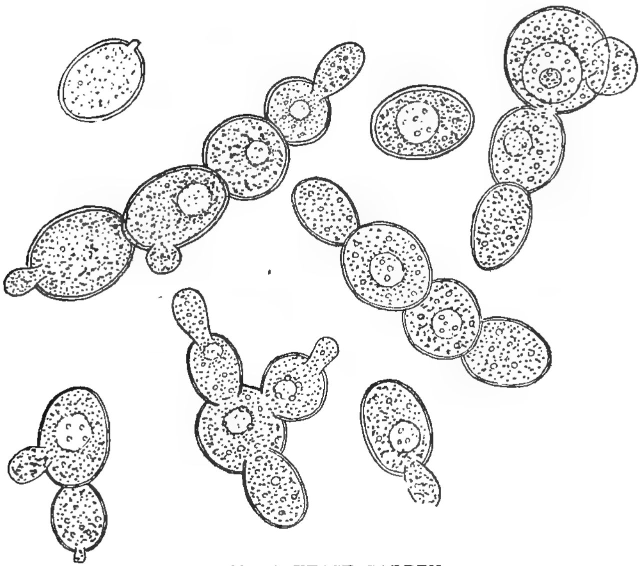


FIG. 23. A YEAST GARDEN.

do not work well under 70° F. and are killed when in a moist state by the temperature of 130°-150° F. No wonder the bread will not rise when the cook pours boiling or even hot water on the cake of yeast! Dead plants cannot work any more than dead animals. No

Favorable Temperature

working by the yeast means no possible raising of the dough by the gas. Sometimes the dried yeast cake has been carelessly prepared in this respect and the yeast plants are nearly all dead.

Cold and Yeasts

The yeast plants can endure cold better than heat.

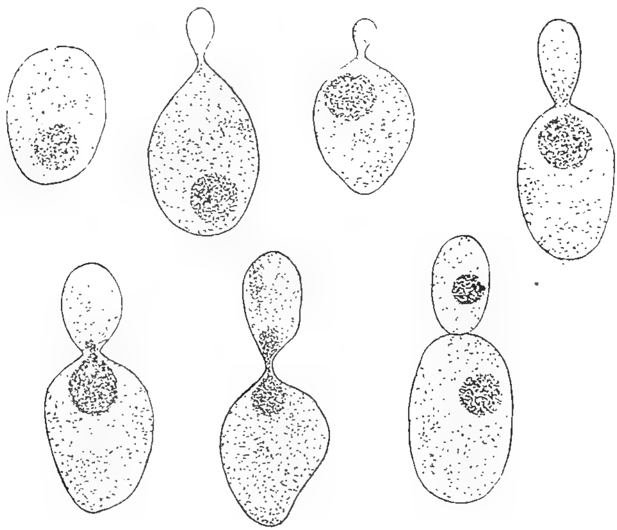


FIG. 24. YEAST PLANTS IN VARIOUS STAGES OF BUDDING OR REPRODUCTION. (After Sedgwick and Wilson.)

It hinders their work but does not quickly kill them.

Experiment with Yeasts

To show the favorable or unfavorable temperature for the growth of yeast plants, take one-half cup each of boiling, lukewarm and ice-cold water. Add to each one tablespoonful of molasses and one-

sixteenth of a cake of compressed yeast. Put each portion into a clear glass bottle or tumbler and place all three in a warm place, about 75° or 80° F., for an hour or two. Watch carefully for the first sign of bubbles which show that gas is forming. Note in which glass the larger amount of gas is found.

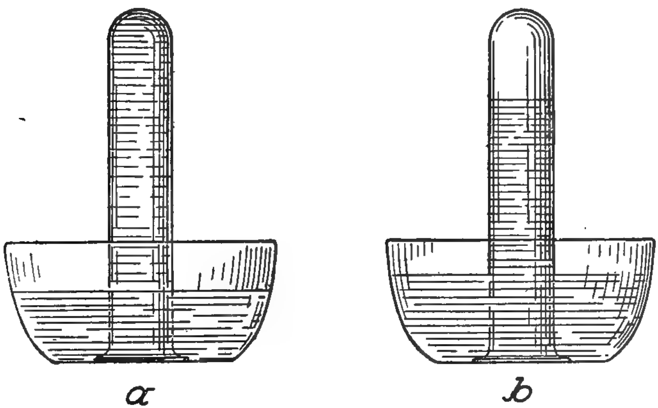


FIG. 26. YEAST GENERATING CARBON DIOXIDE.

(a) Tube filled with molasses and water.
(b) Carbon dioxide collecting in top of tube.

Fill a test tube or thin, clear glass vial with a mixture of molasses and tepid water. Add a little yeast and invert the vial in a dish which also contains molasses and water. Fasten the vial so that it will remain standing, closed, in the dish for a day or more. Fig. 26, *a* and *b*.

The Gas Produced

The gas will be formed, replacing the water in the vial. If a burning match is held in the mouth of the tube as it is removed from the water, the flame will be extinguished. This indicates that the vial contains the gas carbon dioxide; or a teaspoonful of clear lime water may be poured into the vial and shaken about in it. The carbon dioxide present will turn the lime water milky from the insoluble carbonate of lime (calcium) formed.

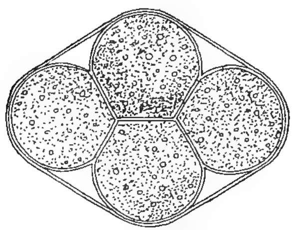


FIG. 25. A YEAST CELL CONTAINING FOUR SPORES.

Compressed Yeast

Compressed yeast is simply a mass of yeast plants mixed with some form of starch and pressed into cakes. A two-cent cake is said to contain over half a billion yeast plants.

As these cakes are made for a special purpose they should contain only one species of yeast. They do, however, contain bacteria and if the dough is allowed to rise too long or at too high a temperature they grow and produce an acid which makes the bread sour; so that sour bread results from the growth of *bacteria* and not from the yeast. When pure yeast is used and all conditions of cleanliness are carefully looked after no sour bread results. A dusty kitchen or unclean utensils may increase the danger from bacterial growth. If the bread be made with milk, this should be scalded to kill the bacteria always present. As we have seen, milk is rich in dust-plants, especially

bacteria, and the dirtier the barn, the cows, the pails, or the clothes and hands of the milker, the more bacteria the milk contains.

Baking Bread

The baking of bread should kill both the bacteria and yeasts, as well as molds, if any are there. But it will not do this unless continued for a long time, because the inside of the loaf will not be raised to a temperature sufficiently high. The moisture in the interior prevents a temperature much higher than 212° and it may remain far below this.

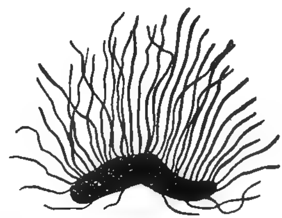


Fig. 27. Bacteria Found in the "Eyes" of Potatoes.

In the laboratory bread has been made from the yeast plants found alive in the center of a slack-baked loaf. The bread should remain in the oven until *well done*, then when removed it should be cooled as rapidly as possible, that all growth of yeast or bacteria may be stopped.

The custom of some housewives of wrapping the hot loaf in thick cloth that the steam may soften the crust is entirely wrong from a bacteriological standpoint.

During the baking the alcohol and carbon dioxide are both driven off.

Coarse Meals

Coarse breads, those containing much bran especially, need thorough baking, because on the outside of the grains are often certain bacteria, the spores of which are very resistant to even high heat.

Some of these are found in large numbers in the soil which clings to underground vegetables, especially in the "eyes" of potatoes. No wonder a vegetable brush is necessary to clean away these clinging arms! Fig. 27.

HOUSEHOLD BACTERIOLOGY

PART I.

Read Carefully. Place your name and address on the first sheet of the test. Use a light grade of paper, write on one side of the sheet only, and leave space between answers. *Use your own words,* so that your instructor may know that you understand the subject. Read the lesson book a number of times before attempting to answer the questions. *Answer every question fully.*

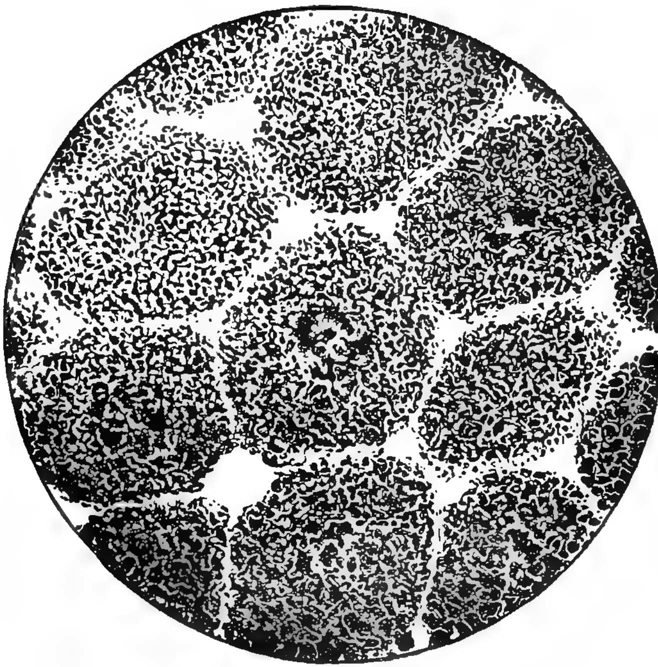
1. What are bacteria? Describe them.
2. What other microscopic forms are found in dust and what are favorable conditions for the growth of these dust-plants?
3. Where are bacteria most numerous and what is their chief work in the world?
4. In what ways are bacteria *helpful* to man and in what way do they *injure* him or his possessions?
5. Why should food eaten raw or unskinned be thoroughly cleaned?
6. What sanitary end is attained by cooking food?
7. Why are oranges and bananas safer fruits than grapes or peaches bought from a street vender?
8. How can scalding apple or other sauce prevent its spoiling, and why scald it more than once?

9. What common diseases in man are attributed to molds?
10. What is mildew, and under what conditions in the house would it be likely to appear?
11. Are molds ever helpful to man?
12. From the health standpoint, what clothes are most likely to need boiling?
13. Why should milk receptacles be thoroughly scalded or sunned?
14. When a can of blueberries ferments or "spoils," what does it mean?
15. Why are bacteria considered to be plants?
16. How do bacteria reproduce themselves and what food do they prefer?
17. What is the typical mode of reproduction in yeast? In mold?
18. What is the chief work of the yeast plant?
19. Give a report of your dust-garden experiment.
20. What do you consider the most important ways in which you have applied the knowledge gained from this lesson?
21. Are there parts of this lesson that are not clear? Have you some questions?

Note.—After completing the test sign your full name.

HOUSEHOLD BACTERIOLOGY

PART II



CELLS OF CLOVER TUBERCULE, SHOWING BACTERIA
HIGHLY MAGNIFIED

HOUSEHOLD BACTERIOLOGY

PART II.

WORK OF BACTERIA

When bacterial life first appeared upon the earth may never be known, but that it existed thousands of years before man made its acquaintance is surely true. Indeed, it was within the last quarter of the nineteenth century that the knowledge of bacteria became of value or was reduced to a science. The problems of bacteriology are now being solved very rapidly. What future generations may add, who can tell?

Although bacteriology is the youngest of all the sciences, it occupies a very important place among them because of its intimate connection with disease, with sanitation or the prevention of disease; with successful agriculture, and with the manufacture of many products.

Useful Bacteria

In the eyes of the law every person is considered innocent until proved guilty. It may be well for us to look at the beneficent role which bacteria play in the world, that we may the more justly consider their harmful work. We can hardly believe that the most numerous forms of life were intended to work only harm to man.

As soon as an organism begins to live it begins to die; that is, certain cells or parts of cells die and are perhaps cast off from the rest that the whole may not be injured. Animals and plants die and become dangerous to the welfare of other animal life, especially to man. The wastes of life, of his own life even, are man's greatest menace.

Fig. 28. Bacteria in Soil which Help in Making Plant Food.

Bacteria as Scavengers

Here come to his aid these microscopic scavengers, the bacteria. No doubt the molds assist in the process but the balance of the work is done by the bacteria present in such infinite numbers everywhere on the earth where organic matter exists.

Through their agency all dead animal and vegetable substances—that is, all organic matter—are changed into inorganic matter, into the chemical compounds or elements out of which they were originally constructed, and which are harmless or helpful to the life of the world.

Fig. 29. Bacteria Found in Soil and on the Roots of Clover, Peas and Other Leguminous Plants.

A tree falls in the woods; an elephant or a bird dies in the jungle; just then and there the millions of bacteria in the soil and the air are ready to seize upon the dead bodies, and in time all the animal and vege-

tables tissues are changed into gases which dissipate into the air or reunite into compounds that form a part of the soil. These then become once more food for plant life, and this, in turn, for the sustenance of animals.

FIG. 30. A VARIETY OF PEA.
(a) Grown in soil with the proper nitrifying bacteria.
(b) Grown under the same conditions without the bacteria.

Bacteria are the agents of decay by which all organic materials are returned to the soil or the air. Thereby life is not only made possible, but also is sustained. What the conditions would be were these invisible agents to cease their beneficent work of scavenging can be scarcely imagined. Life as we know it on this earth could not exist were these dust-plants not present.

All animal life is dependent directly or indirectly upon the vegetable kingdom for sustenance. Man takes both animal and vegetable food, but he is not able to manufacture this food out of the inorganic elements.

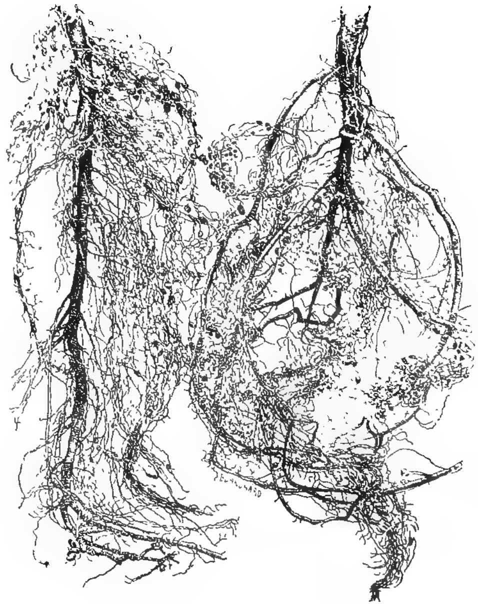
Plants use for their food gases, water, and various salts usually dissolved in the water. In sunlight the

green leaves through their chlorophyl cells are able to take most of their carbon from the carbon dioxide of the air. Some oxygen is also taken from the air, but most of it is absorbed by the rootlets from the ground air, the water in the soil, or from organic compounds in solution in the water. Hydrogen is obtained from water and other compounds containing hydrogen and is taken in through the rootlets.

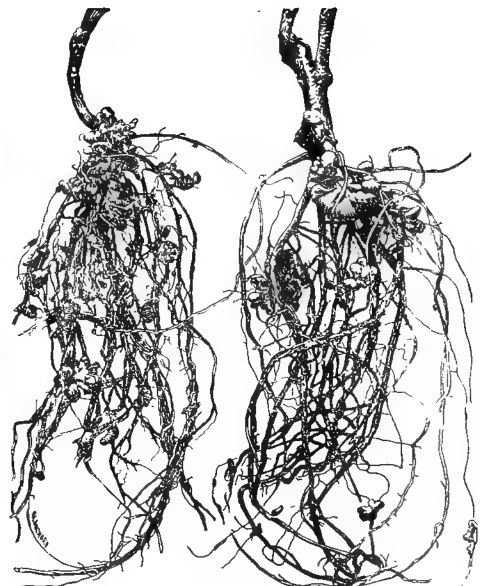
Nitrogen Not Taken Direct

No plants can take their nitrogen directly from the air. Although this gas with oxygen comprises the major part of the atmosphere in which all vegetation is bathed, it is not taken in through the leaves as the carbon dioxide is.

A government bulletin says: "Ever since anything has been known in regard to plant nutrition and the necessary part that various gases and minerals play in the successful growing of crops, scientific men have realized the great importance of conserving the world's store of nitrogen and have made every effort either to husband or to increase all available sources of supply. In the early days, when it was first realized that nitrogen was so essential to plant life—in fact, was at the very foundation of agriculture—no particular alarm was felt. Botanists had demonstrated that plants obtained their carbon from the carbon dioxide of the air, and since this gas is present in so much less quantity than nitrogen it was believed that by no possible means could the most essential of plant foods be exhausted. However, when it was shown that plants



Roots of crimson clover showing nodules



Roots of sweet pea showing nodules.

were unable to use free atmospheric nitrogen and must obtain it directly from the soil in a highly organized form, the importance of the problem increased greatly, and the gravest consequences were predicted by those familiar with the rapidity with which this valuable element was being wasted."—Farmers' Bulletin No. 214, *Beneficial Bacteria for Leguminous Crops.*

Waste of Nitrogen

Nitrogen in combination available for plant food is wasted in many ways. Food and other organic wastes, as sewage, are burned or run into the sea instead of being returned to the earth, which is the natural place of disposal.

There are natural sources of stored nitrogen in saltpeter beds and guano deposits, but these are rapidly disappearing. Even if they were sufficient in quantity they are not everywhere present and therefore must be expensive. Their aid would not be available for all.

Nitrifying Bacteria

The bacteria are more generally present and ready to work. Although unknown and therefore uncredited, they have been working during all the ages since vegetation appeared, not only by their general agency in producing fertility of the soil through the products of decomposition, but also in certain plants through their ability to take from the air its free nitrogen.

From the earliest days of agriculture it has been recognized that all plants belonging to the leguminosae have a decidedly beneficial effect upon the soil. Pliny wrote: "The bean ranks first among the legumes.

It fertilizes the ground in which it has been sown as well as any manure." The lupine and vetch are also mentioned in ancient writings as enriching the soil and supplying the place of fertilizers.

Nitrogen Traps

On the roots of these leguminous plants, clovers, alfalfas, peas, beans, etc., are seen little nodules which have been found to be filled with bacteria. Fig. 29. If these "nitrogen traps" are absent or are removed the plants are less vigorous. Fig. 30 shows the comparative size of two plants of a variety of pea; (a) grown on soil containing the proper kind of bacteria; (b) grown in the same conditions and soil, but without the bacteria. The nitrogen is stored up in the knots, swellings, or nodules on the roots.

Enrich the Soil

Not only do these nitrifying bacteria thus feed the plants which carry them, but also when the plants decay they enrich the soil in which the plants grow. Soils "run out," as the farmers say, that is, there is not plant food enough to sustain luxuriant vegetable life. Here is a place for the legumes to supply with their tiny balls of bacteria the nitrogen which has been withdrawn. In some way, not understood, the clover or similar plant in company with the bacteria stores up nitrogen from the air, which is finally returned to the soil when the decomposition bacteria have accomplished their work, thus making the soil richer in nitrogen.

Inoculating the Soil

When the proper kind of nitrifying bacteria are not present, the scientist comes to the aid of the farmer

and supplies him with artificially grown bacteria with which he may inoculate the soil or seed. If the soil is favorable otherwise, the crop is greatly increased and in time the soil made more profitable for other crops.

Rotation of Crops

The wise farmer does not plant potatoes or corn in the same piece of ground two years in succession, unless he adds large quantities of fertilizer or plant food. He rotates his crops because different species of plants take from the soil different kinds or amounts of food.

Even if these two fields of work—scavenging and aid in agriculture—were all in which we make use of bacteria, their claim of helpfulness would be overwhelmingly proved; but other results of decomposition processes are valuable in the arts and in the commerce of the world.

Fermentation Processes

By the action of bacteria upon the whitish juice of certain plants fermentation processes are set up which result in the blue indigo so important in dyeing industries. Our grandmothers would have been surprised indeed had they understood that their solid bluing was once a white liquid.

Bacteria, too, make possible the retting of the flax, whereby the fibres are separated from the stalk to be finally woven into the beautiful "pictures in white" we call table damask.

They bear their part in the preparation of sponges and in many processes of tanning and tobacco curing.

In these "maceration industries" advantage is taken of Nature's methods of decomposition and what she did for countless ages before man studied her "ways and means" he still lets her do for his own and the world's commercial benefit. Her bacterial agents are as ready to work on the large scale of his planning as on the small scale of the stems of mignonette left too long without fresh water in a vase on our tables.

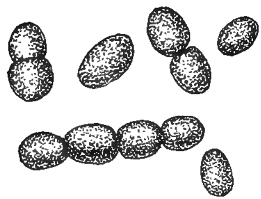


Fig. 31. A Bacterium Which Makes Milk Sour.

Yet these are not all. Not only do they act directly and indirectly in furnishing food to plants, which afterward become food or fuel to animals and man, and prove a source of wealth to man in his industries, but they also greatly increase the variety and the palatability of his food.

Flavor Production

Milk as we know it always contains bacteria and is an excellent culture material for their growth. Such a universal condition suggests some important results to be attained.

Most housewives know that while cream may be sour it is not so sharply acid as the milk from which it was taken. The addition of a little salt or sugar and spices may counteract this acidity and the result be a most delicious sauce. The large amount of fat in

the cream is not a favorable food for the lactic acid bacteria. Fig. 31.

BUTTER MAKING

Butter Bacteria

Butter is usually made from sour or "ripened" cream and this ripening is the work of bacteria. The bacteria which cause the ripening are of different species, which grow best at different times and under different conditions. As the result of their growth are produced many different odors or flavors in the cream and the butter. Those that make the most desirable flavor, aroma or taste flourish best in May or June in this part of our country. Therefore, butter made from cream ripened by these bacteria has the qualities which have made "June butter" a synonym for the best. Figs. 32 and 33.

Fig. 32. A Bacterium Which Gives a Pleasant Odor to Butter. (After Conn.)

Conditions over which the housewife has little control may interfere with the products. If the weather be warm and moist, the cream and butter need different care than when the temperature is low, the air dry or the climate equable. She therefore tries to produce an artificial climate by putting her cream and churn in a cold room and the butter in the refrigerator.

This flavor production is a true process of fermentation or decomposition and like any other must be stopped at just the right time or results most undesirable will be obtained.

The skilled butter maker knows how careful she must be with dairy floor and shelves, milk pans, skimmer and churn as well as with the milk, the time of skimming, the temperature and age of the cream, etc. From milk kept in some dairies it is impossible to make good butter — the wrong kind of bacteria are there. This is usually the result of uncleanness somewhere, it may be outside the dairy or it may be within.

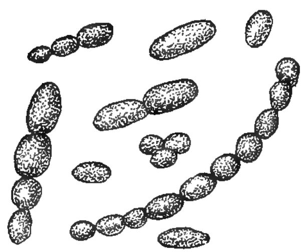


Fig. 33. A Bacterium Which Makes Good Tasting Butter.

This natural process of cream ripening may do for the small home dairy where all milk and its care can be under constant supervision; but in the public creamery, which receives milk from many breeds of cows under varying conditions, such chance ripening would lead to failures and much financial loss.

June Flavor Bacterium

When a pink or a rose is found to have a peculiar fragrance, color, or shape, or to keep longer than others, and this is perpetuated by cultivation, why not a certain "June flavor" bacterium? This is just what is done. Fig. 34.

The first experiment in the culture of "butter bacilli" was made from a specimen of milk which came from South Africa and was exhibited at the World's Fair in Chicago in 1893.

This was named from the scientist who introduced the culture, "Conn's Bacillus No. 41."

Now there are other varieties which are cultivated for the purpose.

The butter of different countries varies much like that of different dairies in the same country. Now, any desired flavor may be obtained if a pure culture of the proper bacterium is used and the conditions of manufacture are understood and carried out.

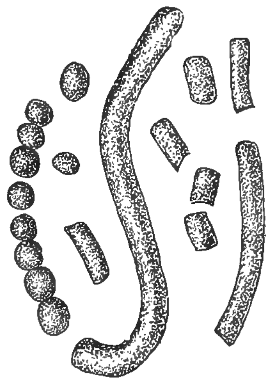


Fig. 34. A Bacterium Which Is Cultivated and Sold to Butter Makers. (After Conn.)

The culture introduced into the cream is known in the United States as a "starter."

"Starters"

There are different methods of using the starter, but one in common use may be outlined thus: "The pure culture is added to a small portion of Pasteurized milk and allowed to grow. At the right time and temperature a certain amount of this 'starter' is added to the Pasteurized cream." All the factors of success are kept under control; nothing is left to chance. The extreme meas-

ures taken to insure cleanliness are a revelation even to the neatest housewife.

Bad Flavor

Not all bad flavors in butter are due to the wrong bacteria or to molds. The food and physical condition of the cow may affect the flavor of the milk and therefore of the butter, but certain distinctive tastes or appearances, as an oily or soapy taste, bitter or ropy milk, red, blue and other colors in milk, which were formerly attributed to diet or disease in the cow are now believed to be the work of various micro-organisms. Fig. 35.

Fig. 35. A Bacterium Which Makes Milk Red.

These are diseases in the milk as much as the fermentations in our bodies brought about by germs of consumption or diphtheria are diseases. Both are the work of germs which have gained access through, or are working under wrong conditions.

Health in the human body as well as health in food supplies means conditions unfavorable for the growth of any germs or those conditions favorable only for the growth of helpful forms. For this end the bacteriologist is always working.

CHEESE

Ripening Cheese

Cheese is made from the casein of the milk and is a most valuable proteid food. However, it is seldom

used as food until a ripening process has been carried on which gives it the most desired flavor and increases the digestibility of the albuninous matter by making it easier of solution. The change of the liquid milk into the solid curd is a chemical change, but to numerous species of bacteria and molds we are indebted for the many varied flavors which tickle the nerves of taste.

Certain species grow best in damp, dark caves, and some of the foreign, strong, highly-flavored cheeses are ripened in these caves.

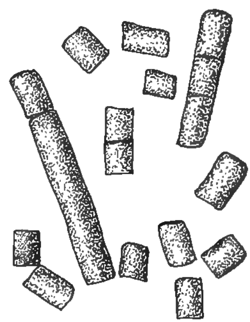


Fig. 36. A Bacterium Which Makes "Swelled" Cheese.

Some species produce large quantities of gas which puffs up the cheese or leaves holes, large or small, few or many, according to the number of bacteria present. Fig. 36.

Molds in Ripening Cheese

In some kinds of cheese, large holes are made in the finished product and *mold* spores inserted. These grow and give the characteristic flavor to the food. This is seen in the "Roquefort" which was first made in a French village of that name from sheep's milk. Brie, Stilton, and Gorgonzola are also allowed to gain flavor from molds, while the Edam is inoculated with a bacterium. Sometimes the fermentations develop poisonous products of putrefaction which may result

in ptomaine poisoning. This would be putrid cheese.

As with cream, so the cheese curd may be inoculated with the particular germ which, by its growth and life processes, is known to give the desired flavor, just as a person may be inoculated with a certain disease germ. In both the processes are similar, although the results are different.

Bacteria Necessary for Flavor

If cheese be made from boiled or Pasteurized milk or from that to which a germicide has been added, the ripening process does not go on, showing that the living micro-organism is necessary to the production of the desired flavors.

Pure cultures are now used for cheese ripening and therefore cheeses that have heretofore been imported, because the species of bacterium necessary was not native to this country, may now be made here when the conditions of growth are understood.

Butter and cheese are possibly the most common foods whose desirable and varied flavors are due to bacteria and molds, but there are others where their work is often productive of a pleasant taste.

VINEGAR

Anyone who has seen a cider mill in-operation in the country or has seen the cider made "while you wait" at a city fair knows the process by which the whole apple is crushed and the juice extracted. Such juice must, of course, be seeded with wild yeasts and with bacteria which were on the skin of the fruit or in the air. When it runs directly from the press, it

is only very slightly acid, but if allowed to stand for a while it becomes sharply acid. This acetic acid is the result of bacterial growth and finally turns the sweet, pleasant drink into hard cider or cider vinegar. Fig. 37.

Sugar to Acetic Acid

The process of change is a complex one, due to both chemical and bacteriological agencies. When the

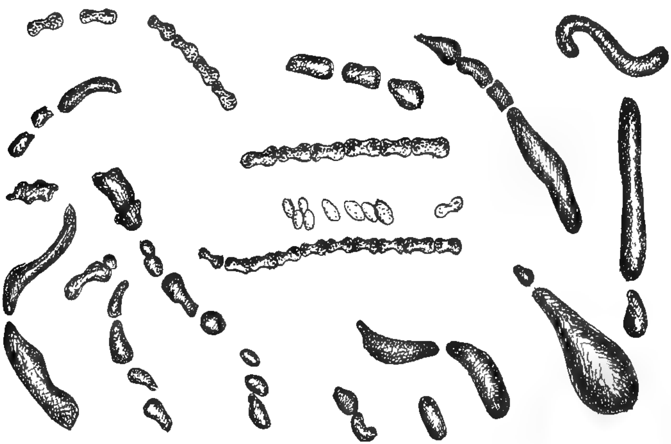


FIG. 37. BACTERIA WHICH MAKE ACETIC ACID AND VINEGAR. (After Conn.)

wild yeasts have brought about the alcoholic fermentation of the sweet apple juice certain bacteria take up the work and produce acetic acid in a weak solution which we know as vinegar. There are different species capable of producing acetic acid of different strengths and under different conditions. What is known as the mother-of-vinegar is a dense mass of bacteria—a true zooglœa form. Fig. 38.

These are the agents which make the vinegar.

Not all vinegar used in the household is made from cider. The large manufactories usually use alcohol or wine as the base of the process. Alcohol and acetic acid contain the same elements in different porportions, the former having less oxygen. The bacteria of mother-of-vinegar are able to take oxygen from the air, cause it to unite with the alcohol, and thus make acetic acid. In actual practice a weak alcoholic solution is allowed to trickle slowly over beechwood shavings. In this way a large surface is exposed to the air. It is found that if the shavings are sterilized, that is, if all micro-organisms are removed, no acetic acid is formed, thus proving that here again we are indebted to our dust-plant friends.

FIG. 38. Bacteria in "Mother-of-Vinegar."

Butyric Acid

Lactic acid, the acid of sour milk, and acetic acid, the acid of vinegar, are two desirable acids due to bacterial growth, while a third, butyric acid, not desirable to the housewife, results when such growth takes place in fats. This is the chief cause of rancidity in butter and other oily substances and the similar taste or smell in old milk. To the housewife this means loss of food supplies and therefore comes under the unfriendly work of dust-plants.

The harmful work of bacteria and molds so far is seen to consist of two kinds, the production of unfavorable conditions in food supplies, and in or on other property, as mildew on clothes, books or furnishings; in short, diseased conditions of our possessions. These diseases, if not cured, may be serious enough to destroy the property, while they may also cause similar diseased conditions in our own bodies, more or less severe, which may result in death.

Life Work of Dust Plants

Bacteria sour our milk, our sauces, our fruit juices; they not only "ret" the flax when we wish them to, but they rot wood when we do not want them to; they make meat putrid and butter rancid; molds spoil our bread and jellies and clothes. All these things the dust-plants will do unless we prevent them, because they are in the world to soften, to decompose, and thus to "get rid of what has ceased to live." All such substances are food for them and feeding is their way of working.

We must know how to prevent their work when it interferes with our interests. We must prevent their growth by removing conditions which are favorable or we must kill them.

An experiment which anyone can try will suggest what favorable or unfavorable conditions are and in what way science seeks to help the housewife to preserve both her property and her health.

Experiments with Bacteria

Experiment III. Take seven clear glass bottles, number or mark each in some way. (Small laboratory flasks with flat bottoms are convenient for this purpose.) Put into each one-half cup or less of milk or grape juice.

Leave No. 1 open in a warm room, not in direct sunshine.

Fit No. 2 with a full plug of cotton wool about one inch long. Put with No. 1.

Have No. 3 like No. 1, but place immediately in an ice box.

Drop into No. 4 one tablet or "saloid" of corrosive sublimate. This can be bought of a druggist. Mark it "Poison." Plug like No. 2 and place it with No. 1.

Plug No. 5 with cotton wool like No. 2. Put it into a steamer and steam for thirty minutes three days in succession. Place it with No. 1.

Fit No. 6 with a tight cork. Remove the cork, but place it with the bottle in the steamer and steam as you did No. 5. Cork each bottle while the steam is coming out. As the cork cools and shrinks, tighten it.

Put a cotton wool plug into No. 7 and heat for half an hour from 155° F to 165° F.

After completed preparation, keep all but No. 3 under the same conditions and note any changes that occur. Test the open bottles with strips of blue litmus paper from the druggist's. See if the contents change the paper any more rapidly or completely after two or three days than at first. Test by smell and taste all

but No. 4, the one in which was put the corrosive sublimate. This is a poison to human beings when taken internally.

No. 1 is open to air and dust and in time will become sour or undergo fermentation. If left long enough the milk may putrify.

No 2 is closed to dust but not to air. However, no pains was taken to free the bottle or plug from the dust which was on them or in the contents, so in time this will become sour.

No. 3 has all the conditions of No. 1 except warmth, which is favorable, and light, which to some dust plants is unfavorable. It should not spoil or sour as quickly as No. 1.

No. 4 has been treated by a chemical which is poisonous and should kill the dust-plants present. This, if strong enough to kill, is a *disinfectant*. If only strong enough to prevent or retard growth for a while it would be an *antiseptic*. There should be no change in No. 4.

Intermittent Sterilization

No. 5 will have been sterilized, that is, all life within liquid, or bottle, killed by the steaming process. The first steaming is expected to kill all the growing or vegetative forms then present. It may not be enough to kill any spores that are there. These will be encouraged to grow by the greater heat, but on the second day they will have developed into the ordinary growing form and the steaming should kill them. That sterilization may be assured and any possibly

resisting microbe destroyed, a third steaming is given. This is called intermittent sterilization. No. 5 should keep indefinitely. It will, of course, dry away slowly through evaporation.

No. 6 is like No. 5, only closed from the air which passes through the cotton wool, and if the cork was sterilized it is impervious to dust. Some corks are not solid enough to keep the bacteria from growing through the cavities. Such corks need to be dipped in melted paraffin. They are then as tight as a glass stopper. No. 6 should keep, as well as No. 5.

The woman who put up her grape juice in corked bottles, to find some years after that she had grape wine, either did not thoroughly sterilize the juice, the bottles and the corks, or the latter allowed dust to pass or mold to grow through. She should have covered the corks with melted paraffin to prevent such a possibility.

Pasteurization

No. 7 varies from No. 5 only in the time and the degree of heat to which it was subjected. In the case of milk—where the process is most commonly used—this is called Pasteurization. It is sufficient to kill most if not all the souring bacteria and all the disease-producing or *pathogenic* germs. It does not affect as unfavorably the digestibility of the milk as sterilization, 212° F, or higher is found to do.

Pasteurized milk will spoil eventually because not all the germs are killed. Pasteurization is valuable for protection from disease germs and to improve the keep-

ing qualities of milk or cream. As it is not a process of sterilization, such milk sometimes grows putrid or bitter without souring.

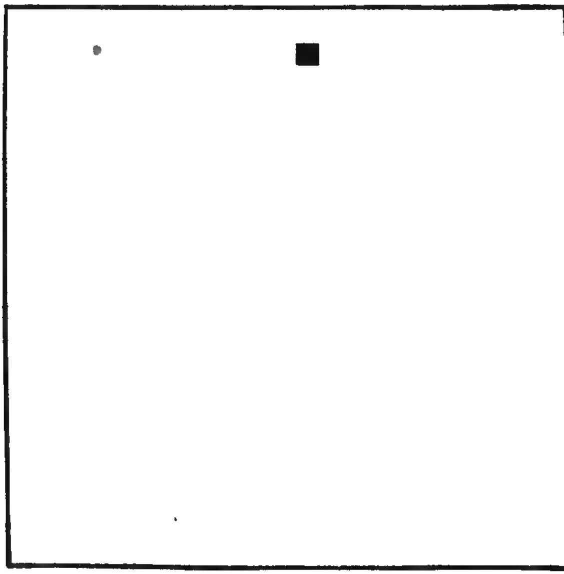


FIG. 39. Diagram Showing Effect of Pasteurization Upon Milk.

Fig. 39 represents the change which takes place in the germ content of milk during this process. If we represent the germ content of a sample of raw milk by the size of the white square, then the black square will show the same after Pasteurization.

All additions of bacterial poisons are liable to injure

the persons using the milk; therefore, in most cases, such additions are contrary to law.

PRESERVING FOOD

The following from the U. S. government bulletin on "The Use and Abuse of Food Preservatives," will show us that man has always sought to prevent the use of his food by these micro-organisms:

"In hot, arid regions the question of the preservation of food is of little interest. An animal may be slain and its carcass hung in the air to dry. Other foods keep correspondingly well. Putrefaction and decay are almost unknown. On the other hand, wherever climatic conditions favor decay this question becomes important, especially for those who live at a distance from markets and who kill and preserve their own meat, and for those who, either on land or sea, are for a number of days remote from a source of supply.

Common Methods

"The methods most commonly employed for preserving food, by drying and smoking and with salt, vinegar, alcohol, and sugar, have long been known. Some of them are probably as old as civilization itself, and indeed are not unknown to many tribes of savages. We are told by Herodotus that the ancient Egyptians were conversant with the art of preserving meat with salt, and six centuries before the Christian era Cyrus sustained his troops on long expeditions with salted meat. The aborigines of North and South America were accustomed to cure their meat by smoking or "jerking" (tearing from the bone in long strips and

drying in the sun), according to the requirements of the climate. The preservation of meat by salting, drying, and smoking is practiced in Oriental countries by a number of the Mongolian tribes, including the Tartars and the Chinese.

"It is a matter of common information that these methods are still employed largely in civilized countries and not alone by those in rural districts who preserve their own meat. Our large packing houses smoke immense quantities of meat with hickory wood. One establishment in Chicago has 43 smokehouses, each of which holds 60,000 pounds of ham or shoulder or 120,000 pounds of side meat, besides 11 houses of half that capacity. Meat so preserved is recognized as wholesome. It is not always suitable for the sick room, but its taste is a sure indication of its character and the method of its preparation. This makes it impossible to mistake these products for fresh meat, and thus removes the great temptation to fraudulent practice that attends the use of tasteless preservatives. The preservation of meat by freezing has always been practiced, and in localities where the temperature favors this method nothing else is to be desired. Until recently, however, this method has necessarily been of limited application. * * *

No Tasteless Harmless Preservative

"No tasteless food preservative has been suggested which is entirely nontoxic, and which does not have a marked influence on digestion, even when taken in relatively small doses. Some there may be whose anti-

septic action is so slight that food treated with the minimum amount necessary for its preservation is not unwholesome for adults in normal health. But in any case food so treated should be plainly labeled with the name and amount of the added preservative."

Sugar Condensed milk keeps because most of the water has been taken out and a large percentage of sugar added. This results in a thick, pasty mass, enclosing very little air, in which the few germs which survive the heating that the milk undergoes cannot grow and work. Decomposition is thus retarded or prevented so long as the milk is not exposed to any fresh deposit of dust. The contents of an open can will soon show mold or give other evidence of spoiling and when diluted to the consistency of ordinary milk will sour like fresh milk.

Drying Fifty years ago the country housewives dried their own apples, plums, raspberries and blueberries for winter use. This drying of uncooked fruits is simply an antiseptic measure and they must be kept dry or they will spoil. They must also be carefully cleaned before use. Some of the germs are killed by the drying process, but others enter the spore stage and are ready for work when moisture is furnished.

Canned Goods The present-day housekeeper owes much of the variety in her food supply to the possible preservation of fruits and vegetables through sterilization. "Canned goods" are sterilized by means of steam or boiling. The same process, of course, cooks the food, thereby

killing any bacteria or other germs which might be in the vegetable or animal tissues. The cans are sealed while hot.

In the household similar processes are carried on. To insure success, everything which touches the food should be sterilized—the jar and its cover, spoons, ladles or funnel. Hands and towels should not touch the edges of the mouth of the jar nor the inside of the cover, for they may carry dust enough to reinfect the fruit.

"Spoiling"

When the canned food ferments or spoils it means that in some way it was not thoroughly sterilized or that dust-plants gained access to it afterward. Where sugar is used it should, of course, be put in before the sterilization, not afterward, unless it is made into a syrup and sterilized by boiling. If the housewife remembers that everything is dusty; that dust means dust-plants; that dust-plants mean the germs of fermentation and putrefaction, or "spoiling;" that nothing short of sterilization will insure indefinite "keeping," she will know with what she is dealing and may act intelligently.

If all dust could be removed from the air, the latter might have free access to her cans and no souring would follow. They might dry up, but they would not "spoil." If the jar of food be completely sterilized, it can be stored anywhere in light or dark, warm or cold places; no fermentation occurs. But the chances of partial sterilization—a misnomer, of course, for such

a condition is not one of sterility—are so many that the cold place adds the antiseptic "ounce of prevention." So far as the bacteria are concerned, in the sunshine would be the best place to keep such stores. This, however, would in time fade the food and under some conditions would help to dry it, or crystallize the sugar. Here, as elsewhere, there must often be a choice among unfavorable conditions.

Acids as Preservatives Some food supplies, like rhubarb, are so strongly acid that bacteria will not grow in them. This is sometimes canned in cold water with no cooking. Tomatoes and cranberries are sometimes canned in this way.

Bacteria do not like strong acids, so the housewife saves her cucumbers, tomatoes, etc., by making them into pickles. These, however, will mold.

Essential Oils The essential oils, as clove, cinnamon, mustard, etc., are antiseptic in their effects. They possibly lend their aid in the preservation of the fruit as well as in adding flavor. Mustard, especially, has strong disinfecting properties. Perhaps this is its greatest value as a condiment, for it may act upon the bacteria liable to cause fermentation in the digestive tract.

Salt Strong solutions of salt prevent the growth of bacteria. Common salt, both in brine and as powder, is perhaps the oldest preservative, and although it makes most food stuffs less digestible it is probably the least harmful of any antiseptic substances. This cannot be said of borax, boracic acid, salicylic acid, the sulphites and formaldehyde (formalin); all of

which when strong enough to hinder the growth of bacteria are thought to interfere more or less with the digestive processes of man. The use of any such substance is prohibited by the U. S. pure food law.

Clean Eggs

It would seem that eggs at least should be free from bacteria because of their enclosing shells. But experiments have shown that the newly-laid egg is sometimes infested with bacteria and their growth may bring about the decomposition of the egg.

The more common danger, however, is that of unclean conditions of nest or storage. The shell is porous to air and also, it has been found, to certain bacteria. The shells, then, should be clean. Eggs are often preserved by a coating of shellac or in lime water. These methods exclude air, without which any germ inside cannot grow, and they prevent any germ on the outside from passing through the shell.

We see, then, why eggs should be kept in a clean, cool place, and if packed, the packing boxes or material should be clean. Eggs are often tainted by moldy packing boxes, sour hay, or dirty straw.

Some of the less common acts of bacteria are interesting even if we suffer by them.

Dust Garden Planted Out of Doors

Fig. 49 shows a plate which was placed on the outside sill of a second-story window on the back of a city house. This window overlooked an open field bordering on a large body of water. It was not, therefore, an especially dusty position and the day was quiet, with little wind. The fact that so many dust-plants were

caught in the twenty minutes' exposure shows the condition in which uncovered jellies, puddings, sauces, etc., are likely to be when placed in such places to cool; therefore, it is not surprising that lemon jelly, jellied meat, etc., are sometimes found in a liquid condition in such a place.

Liquuefying Bacteria

As we have said, some of the bacteria are capable of liquefying gelatine. If the right species of bacteria had happened to be present in the dust which settled in this place, nothing could have prevented the gelatine being liquefied, because the presence of the liquefying bacterium would have been unknown until its work had been done. A slight liquefaction is shown at the largest spot in Fig. 46.

The teacher who followed a lesson on the dangers of dust by one on lemon jelly which she placed uncovered in the open window to cool, did not apply the scientific knowledge which she had. If she had done as well as she knew, the contents of her mold would have remained jelly and not become lemonade.

We have seen that these dust-plants may spoil our property and thereby cause us much expense. Did they do nothing else, we might not spend so much time or labor in studying them and their work.

Just as among the hundreds of beautiful flowers in the woods and fields there is a "poison dogwood;" or

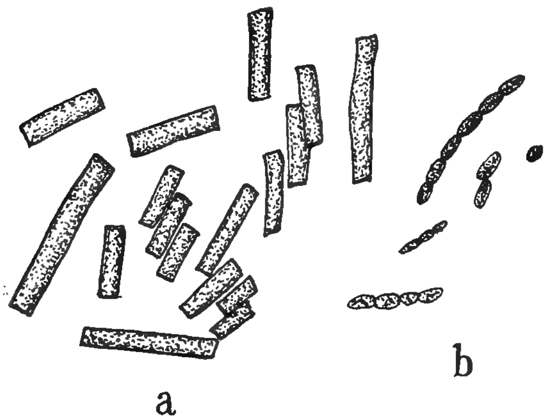


FIG. 40. THE BACILLUS OF TUBERCULOSIS.
(a) Taken from lung tissue. (b) As sometimes found in the sputum.

among the luscious mushrooms a deadly "Amanita;" or as in a great city among the thousands of honest, harmless, law-abiding citizens there is an occasional thief or murderer; so among the millions of helpful bacteria there are a few which in man and animals cause disease of greater or less virulence.

Communicable Diseases

These are called infectious or contagious diseases. They are carried either by actual contact with dis-

eased tissues; by inhaled dust, as most often in tuberculosis or consumption; or by food or drink in which was the germ which is capable of causing a specific disease—as typhoid fever, diphtheria, etc, or through some wound in the skin. Figs. 40, 41, 42.

No Germs No Disease

If the *specific germ* of typhoid fever, tuberculosis or pneumonia, etc., is not present the disease will not appear, no matter how "run down" or "below par" the person may be. But any condition short of normal health—any weakening of the body by cold, indigestion, fatigue, overheating, lack of nourishment, etc., tends to lessen the resistance in some part or the whole of the body and makes the attack of any germ which comes along more surely successful.

FIG. 41. Bacillus of Diphtheria. (After Conn.)

Any inherited weakness, as weak lungs, sluggish circulation, imperfect digestive powers, increases the danger or liability to attacks of germ diseases.

Favorable Conditions

Given the germ under favorable conditions for its growth, it is then a question of the resistant power of the individual, aided, perhaps, by medical science, whether the body or the disease will gain the victory.

Origin of Disease Germs

It is believed by some scientists that the commonly prevalent species of bacteria, harmless under ordinary conditions, may change their character when settled in thickly crowded centers of population where darkness, dampness, bad air, insufficient or poor food make filthy habits of life. If these then gain access to human tissues they may develop disease-producing power and be carried far and wide. In this way cholera, the "plague," and similar diseases, beginning in countries or sections of cities where human beings herd together with no pretense of cleanliness, are carried across seas and continents. This would show how necessary to the physical health of the world is the purification of "the slums," whether these occur at home or abroad. Other bacteriologists deny this hypothesis, but however the disease germs may have developed their evil ways, they never, so far as we know, reform of their own accord and become harmless, although unfavorable conditions may weaken their power or virulence.

FIG. 42. Typhoid Bacillus Showing the Many Cilla. (After Sedgwick and Wilson.)

Breeding Ground for Germs

The bacteria which are the cause of typhoid, diphtheria, or tuberculosis make a specialty of this work. The true parasitic disease germs affecting man must have human beings in which to propagate with any degree of success; so the *human body is the chief natural breeding ground of contagious disease germs.*

Outside of the body disease producing bacteria may remain *alive* under very varying circumstances, but as a rule they do not multiply as most of them require a temperature equal to that of the body. There are exceptions, as, for example, the growth of the bacteria of typhoid fever in milk, and many others which reproduce in the laboratory under artificial conditions. The lower animals may serve as a breeding ground for some of the disease germs dangerous to man.

Point of Attack

For most of these germ diseases there is some special portion of the body which is more susceptible than any other. We associate pneumonia and usually tuberculosis with the lungs, diphtheria with the throat, typhoid fever with certain parts of the intestines. From these most usual points of attack may be inferred the most common methods of infection.

Method of Infection

When the seat of the disease is some portion of the respiratory system—nostrils, throat or lungs—it is probable that dust entering with the inhaled air carried the germ, or it came by contact with the lips, as in kissing; when it is in the digestive tract, that food or drink was the vehicle; or when in the skin or outer tissues, that there was actual contact with the germ either as dust, dirt, or germ bearing material from a previous case of the disease, which gained entrance through some puncture or a break in the skin.

Precautions

When we remember that all such diseased conditions due to germs are infectious, we shall exercise great care in preventing contact with the diseased

part or with articles which have come into contact with it. It should prevent the use of the mouth as a "third hand" for holding miscellaneous articles; the moistening with saliva of envelopes or of fingers to turn leaves, etc., which thence may carry infection to the next user. We should think of the danger to others as well as to ourselves.

This is one of the objections to a common comb and hairbrush, towel, etc. All ready-made garments worn next the skin should be washed before wearing. All garments made under "sweatshop" conditions should be avoided, because of the danger of contagion, if for no other reason. Clothes subject to any infectious discharge, as handkerchiefs, towels, etc., should not be washed with other clothes. When possible, all such discharges should be received upon paper or cloths that can be burned immediately. It is well to take this much forethought for the laundress.

Care of Discharges

Especially with such diseases as tuberculosis, pneumonia, and diphtheria, absolute care should be taken that the sputa or discharges from the nostrils and throat as in sneezing or coughing, are not thrown off into the air to become a part of the common dust. When the person himself is able to control the discharge he should remember that he may thus re-infect himself and also spread the disease. Infected or soiled articles should be immediately disinfected, burned, or boiled. If this cannot be done at once,

they should be kept wet, then the germs cannot easily be spread about except by flies.

Lockjaw

An exception to the usual characteristics of disease producing germs is a bacillus which is common in the soil of certain localities,—the germ of the usually fatal disease known as tetanus or lockjaw. Fig. 43. The living germ or its spore is carried into the warm, moist tissues through a wound in the skin. This usually is made with some sharp object which has come in contact with the ground, as a nail, a rake tooth, a pitch-fork, or a dirty knife. It has been known to follow the bite of an insect. Unlike most disease germs, this bacterium forms spores which makes it very tenacious of life. Its spores will resist boiling or drying for some time. It is said to have been found in gunpowder which would account for the many cases of lockjaw resulting from gunshot wounds. As a result of celebrating the Fourth of July in 1903, 415 deaths from lockjaw occurred in the United States. This number dropped in 1904 to 105, in 1905 to 104, and in 1906 to 89. This decrease was brought about through the proper care of wounds and the use of tetanus antitoxine. Wounds should be cleaned thoroughly and not bound up tightly, as the

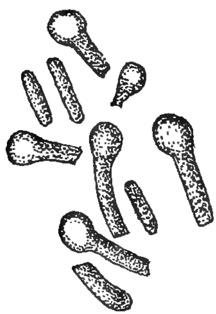


FIG. 43. The Bacillus of Lockjaw.

exclusion of air favors the growth of the tetanus bacillus. Its characteristic spore at one end of the rod has given it the name of the "drum stick" bacillus.

In general it may be concisely stated that infection comes through inhaled dust and that "Food and fingers are the carriers of contagion," as Dr. William T. Sedgwick has so often proved.

The disease bacteria effect their dread results in various ways; sometimes the tissues are actually destroyed, as in tuberculosis, but in most cases the products of the life growth of the germs cause the disease. These products are poisons which are known under the general name of toxines.

Whether in the future the germ theory will be found to explain all diseases we may not now say, but indications point that way. The latest "discovery of the germ of smallpox," if established, is a stimulus to increased efforts along such lines. Animal and vegetable forms are both proved guilty before the bar of the scientific investigator.

Typhoid Infection by Milk

The germ of typhoid fever grows well in milk. The germ may enter the milk as dry dust from any one of many contaminated sources, or through water in which the milk-containing vessels are washed. In cases of dishonest milkmen, from the water used to dilute the milk. Numerous epidemics of typhoid fever have been traced to milk as their source, where only those using milk from one farm or from a certain milkman have been affected.

That the germ may retain its vitality through all the processes of butter-making is proved by its presence in samples of butter examined.

It is not always easy nor possible to find the source of single cases of this or any disease, for the infectious germ, carried as dust, may lodge on any article and be thus carried to the mouth by food or by hands.

Infection by Oysters

Oysters, fattened on sewage-polluted water, have carried the germ to persons eating them. Clams dug out of sewage-saturated flats, when eaten raw, may carry the typhoid germ in a similar manner.

Sewage

In country places where wells are the source of drinking water, or anywhere where surface waters are used directly for this purpose, there is great danger of contamination from drainage, either from the house, its outbuildings, the barn, or manured fields. Contaminated water supply is the most common source of typhoid infection.

As the germs causing the disease are thrown out in the discharges from the intestines and the kidneys, these are the sources of infection. If the discharges from the patient and any articles soiled by these are not destroyed by fire or thoroughly disinfected while moist, there can be no surety that they may not, either as dust or through water, carry infection to someone nearby or even far removed. If such care be taken for every case of the disease, it will soon be no more prevalent than smallpox.

Every case of typhoid fever is due to somebody's

Criminal Carlessness

criminal carelessness, because in the eye of the law ignorance is not accepted as an excuse. Somewhere there has been neglect of the cleanness or care which ought to have made infection impossible.

Pollution of Water

When rain starts from the clouds it is pure, but in falling through the air it washes out from the air large quantities of dust, so that the first fall of any shower is very dirty. Where rain water is collected for drinking or cooking purposes this first fall should be allowed to waste or the whole be thoroughly filtered before its use in cooking. The cistern also must be kept clean and free from dust pollution. It should be sheltered, but not air-tight. Such a water supply is seldom polluted by sewage or any human wastes. It is water running on the surface of the ground or draining through it which may encounter sewage pollution and thus be most liable to take up disease germs.

Snow filters the air even more than rain, each congealed flake usually containing many bacteria. The first snow, although white and pure to look at, is not clean and should not be used as a source of drinking water except in emergencies. However, after the snow has been falling for some time the water from it is practically clean.

Effect of Light

Light always retards and in many cases prevents the development of harmful micro-organisms. But this disinfectant action does not extend to all depths, probably not much beyond nine feet, so that its purifying agency in open water supplies is only partial. A water

supply which receives any house drainage or that from manured fields is in danger of contamination at any time.

Purifying Water Filters

Impure water may be purified from all germs by boiling for half an hour. Such water, having lost the air which was dissolved in it, tastes insipid. The air may be restored by pouring the water a few times from one clean vessel into another, and this should be done in a clean place, that is, where there is little flying dust.

Most filters simply strain out visible suspended matter or invisible but comparatively large animal or vegetable forms. A flannel bag will do this, and it can and should be cleaned daily. It clears currant jelly, why not water? When charcoal forms a part or the whole of the straining medium, more organic matter is removed and therefore more color is taken out, but the charcoal soon loses its purifying power and must be cleaned or renewed. None of the ordinary faucet filters will remove the minute disease germs and thereby make a polluted water safe for drinking. Germ

Porcelain Filters

removal requires a very fine medium, which means slow straining. Certain filters, made of very fine unglazed clay or similar substance, take out the germs themselves, but cannot remove the products of their life processes, which are soluble. In some cases these are as dangerous as the germ plant itself. If a filter does strain out the bacteria, then it is evident that the straining medium will become foul with them and

must be capable of and receive complete sterilization. Any faucet filter which allows a *generous stream* of water to issue *quickly* after it is turned on is practically useless so far as the removal of bacteria is concerned.

Filter Then Boil

A suspected water or one of unknown quality would better be *filtered* and then *boiled* rather than boiled and filtered, if it needs to be filtered to remove suspended matter. Distilled water or water turned into steam and condensed is a pure water; but to remain so it must be received into perfectly clean vessels and not exposed to dust.

Ice

Ice as ordinarily delivered frequently shows three layers. One, usually at the top, the snow ice, is scarcely transparent and when melted shows impurities not visible in the ice. This usually holds many bacteria and should always be rejected. Another layer, partially transparent, is more or less bubbly. These bubbles contain air which allows any living forms therein to remain alive if not to grow. If derived from impure water the bubbles may contain some of the germs which will make the ice undesirable, since many bacteria survive a lower temperature than ice ever attains. A third portion is wholly transparent. This last, the crystal clear ice, is the only ice which should ever be used directly to cool drinking water, for this alone is purified by crystallization although not perfectly.

Ice should always be washed from surface dirt before

it is put into a refrigerator or in any way used for the storage of food. Safety may be assured if ice is never allowed to touch the food. Its effects can be obtained without actual contact and contact may mean contamination.

The tub of lemonade standing open on the picnic ground or the street corner has sufficient chance of germ infection without a block of doubtful ice in its midst.

THE RESISTANCE OF THE BODY TO DISEASE GERMS

Sources of Infection

We have seen that many diseases which afflict human beings have been definitely traced to these organic forms; to these micro-organisms found in inhaled dust, in polluted water, in food and on articles which may puncture the skin.

If the avenues of infection are so common, the question naturally arises, how can any human being escape? We know that many do, that there are hundreds of persons who never have had typhoid fever, diphtheria, or other infectious disease; that two persons may, so far as we know, eat of the same food, drink from the same water supply or live under exactly similar conditions—one has some infectious disease, the other remains well.

It is too a matter of common knowledge that a degree of safety from a second attack is often assured to the person after recovery from the first illness. He seems to have some power of resistance which he did not have before and which is absent in his neighbor.

Yet this safety is not always complete, because some persons have recurring attacks of infectious diseases. This is especially true in diphtheria.

Vital Resistance

There seems to be some power in the robust, healthy, strong body which is absent in the weak and "ailing" or in the body "below par," as the physicians say. Whatever this power is it may well be referred to as "vital resistance."

Dr. William Sedgwick says, "There is, however, no quantitative measure of vital resistance; but when it is regarded as small or altogether wanting, the term is no longer used, and the organism is said to be not vitally resistant, but "susceptible" or "vulnerable" to disease. * * * When the vital resistance is complete * * * the organism is said to be *immune*."

At present no one perhaps knows all the factors which go to make up this "vital resistance" which protects one person and is absent in another, but according to Sedgwick, "We may, it is true, safely consider that it is bound up with chemical and physical processes which result in favorable chemical and physical conditions."

Gastric Juices

In this connection it should be noted that the hydrochloric acid in the gastric juices of the adult is fatal to nearly all of the ordinary bacteria present in uncooked food and to many disease germs. The secretions of the intestines are alkaline and would prove a favorable condition for many kinds did they escape from the stomach. Water passes quickly through the

stomach and may not mix with the acid juices, consequently it is an especially dangerous medium of infection.

Health

Health means the prevention in all possible ways of any chance of attack from the insidious disease germ, but it means as well *the observance of all other laws that tend toward the maximum efficiency of the body and mind, so that if the enemy gains admittance it may be routed or its attack made futile.*

Theories of Vital Resistance

Much has been done along the lines of investigation, yet much of these processes of resistance remain to be proved. A few words concerning the theories put forth by investigators may show our indebtedness to them and increase our own sense of responsibility toward the preservation or return of health.

Leucocyte

Among the red cells which give the familiar color to good, rich blood are other cells known as the white globules or *leucocytes.* They are very much like the amoeba, the lowest animal known, in that they have the power of independent motion. They are sometimes called "phagocytes," or "wandering cells," because they pass here and there throughout the body, wherever they will. Fig. 44. Their office seems to be a protective one, for they act like the police of a city in protecting the body from bacterial invaders. They are also called "eating cells," for when one finds a bacterium it proceeds to wrap itself about the little plant cell, to poison, if not to kill it; then, loaded with the dead bodies of its victims, it makes its way to some part of the body where the load may be disgorged.

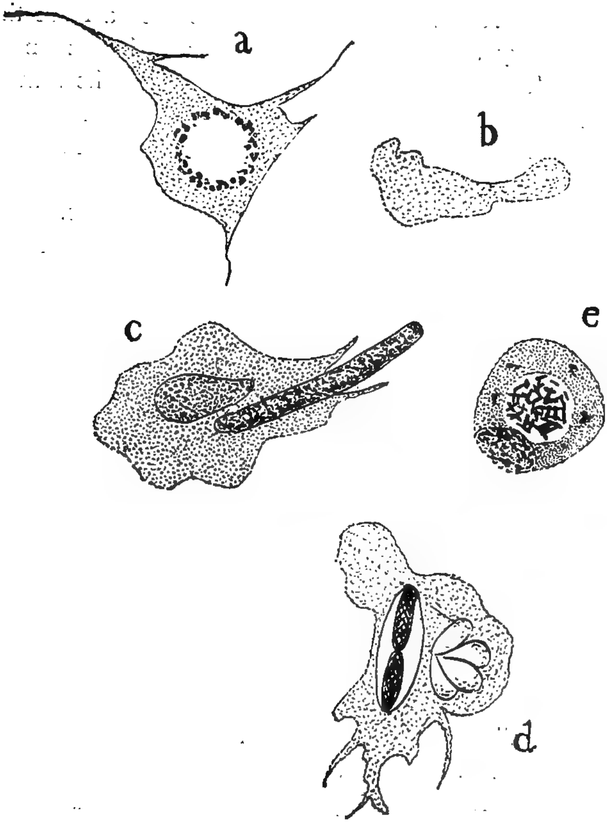


FIG. 44. (a) and (b). PHAGOCYTES.
(c) A phagocyte with partially enclosed bacterium.
(d) A phagocyte with two bacteria enclosed.
(e) A phagocyte with enclosed mass of bacteria. (After Conn.)

It is fortunate for us that there is such a force that is hungry and ever seeking what and how many it may devour, for we can never know just how much we owe to them for our freedom from disease. As long as these white globules are numerous and active, so long man seems to have one powerful guardian against any invading germ, however poisonous. Anything which affects these white guardians unfavorably lessens their power to protect man.

Effect of Cold

Cold paralyzes them and gives the bacteria, if present, a better chance to escape from being overcome, and we are thus more subject to their attacks. Winter's cold increases the prevalence of many germ diseases, not usually by increasing the number or virulence of the germs themselves, but by decreasing in some persons the power of these leucocytes—the guardians of our health.

Insufficient clothing, or insufficient food which is the body's fuel, may thus favor the attacks or the spread of germ diseases. Very often these phagocytes lose their lives in resisting our foes. Then they, with their victims and the dead tissue cells, form pus or "matter," which children even know should be "let out" in order that the tissues may heal.

Formation of Pus

The formation of pus is well illustrated by the action of a sliver. We may or may not know that the tiny speck of wood entered the flesh. But it is likely to carry in with it dirt and therefore bacteria. The phagocytes rally to surround this newcomer. The flesh

becomes red, inflamed and sore, then a "fester" appears. Open the "fester" and a drop or more of pus exudes, in the midst of which will probably be the irritating sliver. The bacteria, the cause of the inflammation, having passed out, the flesh heals. If there has been much bacterial growth there may be much or longer continued inflammation because of the toxines or poisonous matters produced by the germs.

Blood Poisoning

When certain very virulent germs enter the tissues, are unconquered either by the phagocytes or the other resisting powers of the body, the products of germ growth may be rapidly distributed by the blood throughout the body, producing the fatal cases of blood poisoning. The germ was especially virulent, in great numbers, or possibly neither of these, but the body was so "far below par" that it had no power to resist the growth and action of the germs and the toxines which the germs manufactured.

Germs Without Disease

That bacteria capable of producing disease in human beings are far more commonly present than the diseases cannot be doubted. Germs of pneumonia are found in the mouths of healthy persons. Some persons when exposed to infection succumb; others remain unaffected. The old saying that "lightning never strikes twice in the same place" has often been applied to the expressed fear of a recurrence of an infectious disease. Although there are many exceptions to the rule, it is true, as we have said, that in a majority of cases after recovery from such a disease there is less dan-

ger of a second attack. There seems to be great differences also between the susceptibility of children and adults to certain diseases.

Effect of Poisoning

The different ways in which bacteria are known or supposed to bring about diseased conditions more or less severe have been described. Whether these causes are the poisonous excretions during the normal life of the bacteria, or are the result of chemical change produced by some ferment which they secrete, the effects upon the blood and tissues are shown by several common symptoms—a high temperature or fever; quickened circulation or rapid pulse; perhaps difficulty in breathing, and pain. There may be local redness, swelling, and finally the formation of pus, or a "gathering" of the protective phagocytes and the broken-down cells of the diseased portion. These local effects may be entirely within the body or they may be show themselves on the outside under or in the skin. In the latter case a prompt discharge of the pus is usually followed by relief. If there be no discharge and the dead and poisonous matter be reabsorbed into the tissues, there follows a general poisoning of the whole system.

Immunity

Whenever partial or entire immunity seems to be present, we are interested to know in what this immunity consists. Great as is the protective force of the "white guardians" their presence or numbers are not the only factors in immunity.

Metchnikoff, the father of the theory of *phagocy-*

tosis—as the protective work of these "eating" and "wandering cells" is called—has said that "immunity may be inborn or acquired." * * * The former is independent of the direct intervention of human art; the acquired immunity may come as the result of the spontaneous cure of an infectious disease or as the result of direct interference of human art, as in vaccination and similar methods now employed by physicians to ward off an expected disease or to decrease the virulence of one already contracted."

Natural Immunity

This inborn immunity Newman calls "natural immunity" and attributes it to the presence in the blood of soluble matters called *alexines*. If the alexines are present in sufficient quantity, the person is less or not at all susceptible to certain diseases, although they may not protect him from the attack of all disease germs. These alexines protect the body perfectly from all but the pathogenic bacteria.

Toxine

Phagocytosis seems to be a plausible theory so far as the germs themselves are concerned, but does not prove equally tenable in the case of the toxines which the germs have produced. Other investigators, notably Behring and Kitasato, do not believe that the phagocytes are the prime protective agency in this immunity. They discovered in their experiments upon animals that the clear, yellowish liquid part of the blood, or the bloom serum, taken from an animal that had diphtheria could and did in their test tubes destroy the action of the toxines of that disease.

Antitoxine It seems, then, probable that in the blood serum of immune persons there may be another factor in the vital resistance. That is, the body cells in some way manufacture substances that neutralize the poisons or toxines produced by the germs, thus enabling the body to expel the germs themselves, and recover. These *antitoxines* or the power of producing them may remain and the body becomes immune to the disease. These antitoxines are specific in nature,—that is, are capable of neutralizing the toxine of only one kind of germ.

Acquired Immunity Immunity may also be "acquired" by the injection into the blood, in some cases, of the germs themselves, as in the case of inoculation for small pox as was as was originally done in the case of inoculation for small pox. Formerly some "matter," that is, the infectious material, was taken from a person sick with small pox and injected directly into another person by placing it under the skin, where it quickly affected the whole body.

Vaccination Jenner—a celebrated doctor in England about 1796—first modified inoculation by introducing the "matter" into healthy calves or cows. These animals being very susceptible to the disease, contracted it, and then from the pustules of their bodies the "matter" or "vaccine" was drawn and injected into human beings. This, in man, was found to produce a milder form of the disease and to leave in the system upon recovery something which gave immunity or protection from small pox.

Vaccination or Jenner's process is still the recognized preventive or protective measure, and it has reduced small pox from a dread pestilence to a disease producing fewer deaths than measles.

The great Pasteur reasoned that "if an infectious disease be really a struggle for supremacy between man and microbe, it is probable that in vaccination for small pox the struggle is less severe for the patient, because the germs of small pox have somehow been weakened or enfeebled by their residence in the cow."

Making Antitoxine

The use of antitoxine for the prevention or treatment of diphtheria is perhaps the best example of that method of producing immunity. In this case the horse is chosen as the intermediate host for the production of antitoxine material. The toxines, or sometimes the germs themselves, are injected into the body of the healthy animal. The first dose is usually a small one. A slight reaction or fever may be noticed. The doses are gradually increased until the animal is found to be immune. Blood is then drawn from this immune horse and "its serum is found to contain the antitoxine in abundance."

Diphtheria Antitoxine

Some of this serum is then injected into a person who has been exposed to, is likely to be, or is ill with the disease. In the last case, to be effective, the antitoxine must be introduced at an early stage of the disease when there is not too much toxine to be neutralized.

By the use of antitoxine thus obtained, the mortality

from diphtheria has been reduced over one half. Its effects as a preventive measure and in lessening suffering "have everywhere been most significant and encouraging." Antitoxines for lockjaw, for snake bites and for some forms of blood poisoning have been produced and are used with more or less success.

Constant efforts are being made to find an available antitoxine for every infectious disease. Many difficulties present themselves, because the same germs do not always cause the identical disease when introduced into the bodies of the lower animals that they produce in the body of man.

SANITATION

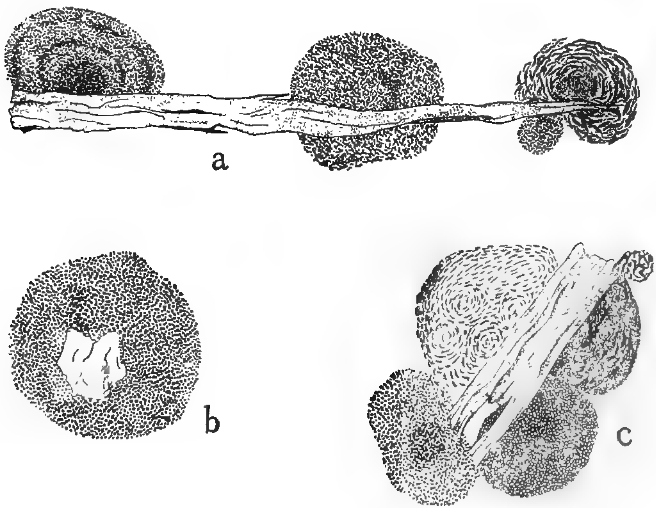
Nature's Disinfectants

As sunshine and pure air are Nature's free disinfectants, their presence in the house is the greatest preventive measure of all sickness due to micro-organisms. They, then, are the foundation requirements for cleanness, because this means so largely the absence of dust-plants.

Conditions in the House

Inside our houses there can never be the same amount of sunshine and fresh air that proves so efficient out-of-doors. The house, too, must be dry, and therefore dust cannot be held as it often is out of doors on damp surfaces. However, the absence of winds inside makes possible, after a little while, a comparatively dust-free air, because the heavier particles which carry the bacteria and molds will settle on all surfaces, chiefly on the horizontal ones, as floors,

chairs, shelves, etc. Figure 45, redrawn from *Dust and Its Dangers,* T. Mitchell Prudden, shows how the living plants attach themselves to the other particles of dust; *a* is a small bit of wood carrying four different



F. 45. COLONIES OF BACTERIA GROWING ON DUST PARTICLES. (After Prudden.)

colonies; *b* is a grain of sand surrounded by one colony; *c* a splinter of wood, is loaded with five different species. Each of these colonies is the growth of five days from a single germ which fell on the surface of the gelatine. At the end of five days the largest was only just visible to the naked eye.

Sweeping

If a dust-garden be planted immediately after

sweeping a carpeted room and another when the same room, with closed windows, has been left undisturbed for two or three hours, there is a marked difference in the number and kind of colonies which will grow.

Dust Gardens

Figures 46 to 49 inclusive are photographs of "dust-gardens" planted in various places by different persons under varying conditions. The plate shown in Fig. 46 was planted after a carpet had been swept with a dampened broom. The plate was left open ten minutes.

The damp broom caught and held much of the dust which would have been thrown into the air if a dry broom had been used. If the sweeping had been done carelessly without thought of the dust, many more plants would have found their way to the garden plot. As it was, the number of spots shows how carefully sweeping ought to be done in order that the air may not be charged with dust which is thereby simply changed in place, not removed from the room. It soon returns to the floor or carpet.

Plate Fig. 47 was exposed for ten minutes in the same place after the room had been quiet for three hours and the dust had therefore settled considerably. The fewer spots show that the air had become much freer from dust than when Fig. 46 was planted.

Settling of Bacteria and Molds

The greater number of molds present in this plate shows that the bacteria, being heavier, settle first. The presence of so many molds shows that even after three hours' quiet, the air may still be sufficiently

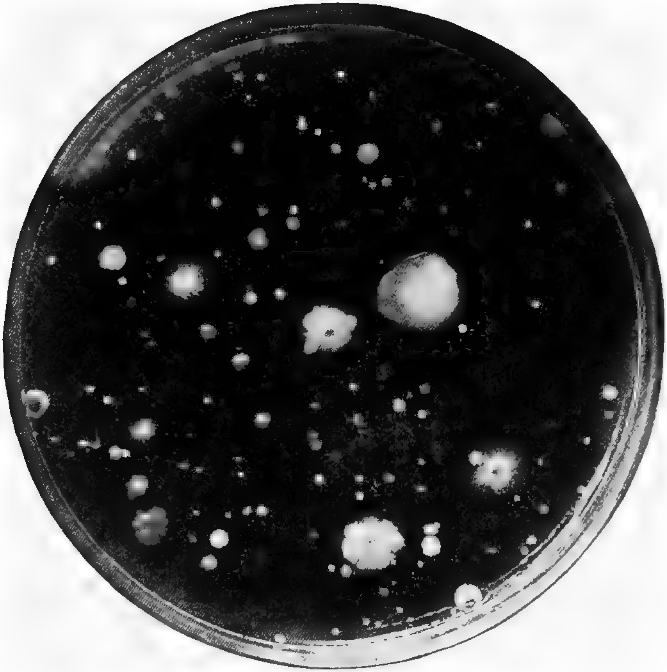


FIG. 46. A PETRI PLATE PLANTED IMMEDIATELY AFTER THE SWEEPING OF A CARPET.

charged with dust to cause trouble if food is uncovered.

Many interesting experiments have been carried on in hospitals to find how long it takes for the bacteria to settle out of the air of the wards after the daily routine of cleaning and care is over, or at night.

In the Boston City Hospital* it was found that about midnight after the wards had been quiet for some hours the bacteria had nearly all of them settled upon the floors, beds, or other articles of furniture. As soon as the work of the day begun many of these, of course, were again thrown into the air. Dr. Tucker found that sweeping nearly doubled the number of germs found in the air.

In some experiments reported by Dr. T. M. Prudden † it was found that in a carpeted living room 75 bacteria and 1 mold settled on the surface of the exposed plate in five minutes before sweeping, when the room was still. Immediately after sweeping, a similar experiment showed over 2,700 bacteria and 6 molds.

Other experiments have compared the numbers found in a certain quantity of air taken from houses considered clean and those called dirty. The latter showed about six times as many bacteria as the former.

Time for Dusting

Compare Fig. 46 with Fig. 47 and decide the ques-

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*Report of State Board of Health of Mass., 1888.

†Dust and Its Dangers, T. Mitchell Pruden.

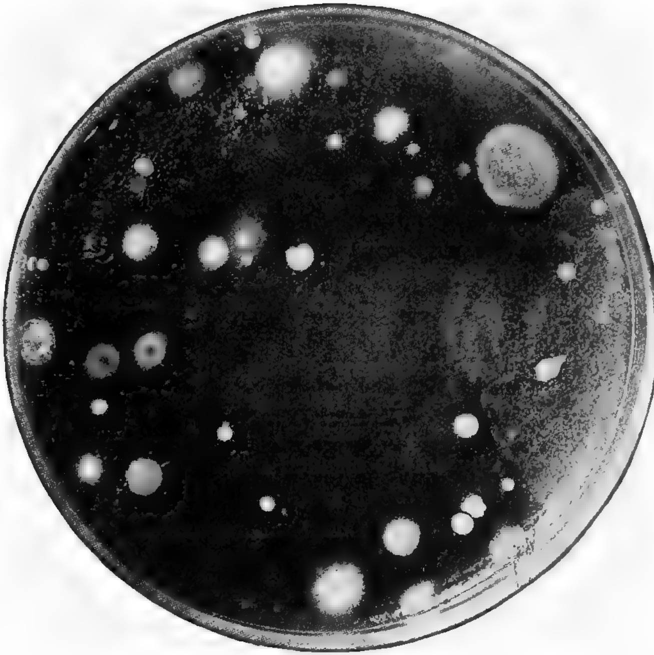


FIG. 47. THE SAME AS FIG. 46, AFTER THE DUST HAD SETTLED THREE HOURS.

tion when dusting should be done, if the aim of dusting be to remove dust from the house. If, then, these and other experiments have shown that at least two hours are required to free the air of a still room from the bacteria present in its dust, it is of little use to dust immediately after sweeping. When this is done, no wonder the housewife exclaims in despair, "Why, this room was dusted this morning, but you never would have known it!"

While we cannot always let *two hours* elapse between some dust-spreading process of housework, like sweeping or bedmaking, we can remember that the raised dust must settle before we can remove it. Wait as long as possible!

When Fig. 46 is compared with Fig. 47, the reason is plainly seen why rugs mean less dust than carpets and therefore a cleaner, healthier house, because these can be carefully rolled, cleaned out of doors, and the floor wiped with a damp cloth.

Bed-making

Next to sweeping as a dust-raising and dust-spreading process comes bed-making.

Fig. 48 shows a plate planted just after a bed had been made. The colonies of bacteria and molds in this plate had been growing for a longer time when the photograph was taken than in plates Fig. 46 and Fig. 47. Two of the molds on this plate are very mature, being black with spores.

As health requires that the air of the sleeping room be as free from dust as possible, considerable time

FIG. 48. DUST GARDEN PLANTED IMMEDIATELY AFTER BED-MAKING.

should elapse after bed-making before the dusting is done.

Removing Dust

To have a clean house, great attention must be paid to the removal of dust, or dusting. In houses where this is done with a feather duster, bed-making gives up its second place to this dust-spreading, never a complete dust-removing process. Dusting should always be done by wiping up the dust into a cloth. Whenever possible to do so without harm, the cloth should be slightly dampened or oiled. Dust-plants are held by damp or oiled surfaces.

If, then, the bacteria do settle from the air on floor and furniture, and in still places about two hours is necessary to effect this comparative clearing of the air, these facts are surely indicated:

FIRST. Sweeping should be done in such a way as to raise as little dust as possible into the air.

SECOND. Dusting should never follow immediately after sweeping.

THIRD. Dusting should be a process whereby dust is taken out of the room, not stirred up and thrown again into the air. Cleanness does not result unless the dust is removed from the house.

Burn Sweepings Wash Dusters

All collections of dirt from sweeping should be burned, and all dusters should be washed. "Burn the sweepings" and "wash the dusters" are two orders which the intelligent housewife will obey.

Cover Food

Dust in the air settles on food and thus produces decomposition. Food then should be kept *covered* as

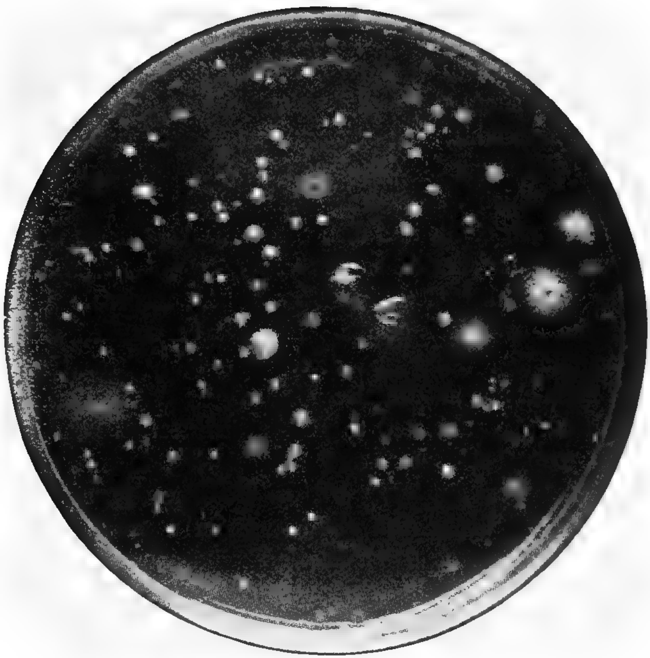


FIG. 49. DUST GARDEN PLANTED OUT OF DOORS.

much as possible, *cold* and dry as feasible, to retard the growth of the micro-organisms present. All foods eaten raw should be *thoroughly* cleaned, especially those that have been exposed to dust, those grown in or near the earth or those watered by *house slops.*

Brush Clothing

Clothes should be well brushed, out of doors if possible; those which can be should be washed frequently, boiled and sunned. All should be kept dry to prevent mildew, which we know is mold.

Deadly Dish-Cloths

That dish cloths and dish towels be kept clean is as necessary for health as for clean, bright tableware. The greasy dish cloth furnishes a most favorable field for the growth of germs. It must be washed with soap and hot water and dried thoroughly each time. All such cloths should also form a part of the weekly wash and be subjected to all the disinfection possible with soap, hot water, and long drying in sunshine and the open air. Beware of the disease-breeding, greasy, and damp dish cloth hung in a warm, dark place! Indeed, no damp article should ever be stored in the dark. The ordinary sink cupboard is a warm, dark and usually a damp place, which even the plumber denounces as an unclean spot.

Care of Plumbing

All waste and overflow pipes, from that of the kitchen sink to that of the refrigerator, become foul with grease, lint, dust, and many organic compounds that are the result of bacterial action. They are sources of contamination to the air of the entire house and to the food supply, thereby endangering health.

The germs of putrefaction abound in dark places and the air becomes stagnant and impure.

Cleaning School Rooms

As the schoolroom bears very close relations to the home, the conditions there should be thought about by the housewife. Either from lack of time or money, wrong methods, or too few employees, the so-called cleaning of many schoolrooms consists in a vigorous sweeping with dry broom or floor brush after school at night. The dust settles during the night, but in the morning, instead of being taken away on damp or oiled cloths, it is stirred into the air again by the whisking feather dusters.

At nine o'clock, in troop the children, with warm, moist throats, eyelids, and nostrils all ready to catch the floating germs which *should have been removed.*

The housekeeping of schoolhouses needs intelligent supervision as well as the mental and moral equipment of their inmates. Where so many persons are gathered from many kinds of homes the danger from the presence of disease germs must be greatly increased over that of the private house.

In dirty schoolrooms, poorly ventilated by windows and doors, compared with well ventilated rooms, the proportion of bacteria in the same volume of air has been found to be sometimes as great as six to one hundred.

The cleaning and cleanness of schoolrooms should certainly interest mothers, next to that of their own homes. This may be their first civic duty.

Sanitary Cleanness

Sanitary cleanness requires the cleanness of the individual, of his possessions, and of his environment. Each individual is directly responsible for his personal cleanness and that of his possessions; but over a large part of his environment he has only indirect control. Not until this personal responsibility is felt in its fullest sense, and exercised in all directions toward the formation and carrying out of sufficient and efficient public laws, will sanitary cleanness supplant the *cure* of a large number of diseases by their *prevention.*

When the right of cleanness is added to the right to be well fed, and both are assured to each individual by the knowledge and consent of the whole people, then the great gospel of *prevention* may make good its claim. Towards this ideal tend all the problems which the science of bacteriology is endeavoring to solve. These problems cannot be solved in the laboratory alone. Each house in the land, presided over by an active, intelligent supervisor, should become an experiment station for the individual application of scientific laws.

HISTORY OF BACTERIOLOGY

The science of Bacteriology is still young, and like normal youth is marked by constant, vigorous growth, yet the micro-organisms with which it deals are veritably antique, for the following quaint observation is said to have been made two thousand years ago: "It is to be noticed that if there be any marshy places, certain animals breed there, which are invisible to the eye and yet, getting into the system through the mouth and nostrils, cause serious disorders."

Spontaneous Generation of Life

Later on when the early scientists were looking through their very imperfect lenses at certain liquids, they saw many hardly visible moving bodies. They said, "Surely these moving things must be alive," and as they had not put anything into the liquids, it was natural to conclude that the little forms must have been spontaneously generated. So great a thinker as Aristotle had previously made a similar statement, for when he saw birds one morning flying about over the valley of the Nile, where the day before not a bird was present, he devoutly concluded that they must have been generated from the mud of the Nile, that great Father of Plenty. It is within the memory of some living today that this theory of spontaneous generation was still believed.

Animalcules

About 1675 Leuwenhock, the son of a Dutch lens grinder, saw through one of his lenses in a drop of stagnant water minute moving forms. Soon some of the scientists became interested and studied these "animalcules" or little animals, as they were called. They

made drawings of what they saw, which show very much the same forms that would be seen today under similar conditions. Many scoffed at these reports, intimating that such observers were not wholly sane.

Early Theory of Fermentation

The processes of fermentation and putrefaction very early excited investigation. Great efforts were made to find out their cause. For years the oxygen of the air was thought to be the agent, and even today many a housewife will tell you the jar of fruit spoiled because "the air got into it." The dust-plants which are in the air, the real cause of these changes, could not be discovered until the compound microscope brought to view the hitherto invisible life which swarms in all fermenting and putrefying matter.

The compound microscope was invented in the early part of the seventeenth century, by whom is not known. It was not brought to its present simple but effective form until about sixty years ago.

One of the first sources of bacteria for these early investigations is still a common and sure source.

Meadow Tea

Take a wisp of hay and soak it in lukewarm water for a day or so. The result is a brownish liquid looking much like tea, which it is, being an infusion of hay. Thoreau called this "meadow tea." A drop of this under the microscope furnishes a lively menagerie, as well as numerous bacilli. The hay is dusty; in the dry dust are spores of bacteria which under the influence of the warmth and moisture become once again active forms and can be seen to go through all their life processes.

A drop of water from the neglected vase of flowers will often give similar interesting phenomena.

Work of Pasteur

The modern work upon bacteria was begun and the foundations of the science of Bacteriology were laid when Louis Pasteur in France, less than sixty years ago, began to grow and cultivate these dust-plants. Since then the advance in knowledge about them has gone on with ever increasing rapidity.

If it is possible to increase the power of the microscope or to so train the human eye that it may see more than is seen at present, would greater wonders be revealed? Such a possibility is ever before the enthusiastic student.

Koch's Theory

About twenty years after Pasteur, Robert Koch declared that he believed bacteria were the *cause* of disease and not the *effect,* as many had thought them to be. He began to grow bacteria on potatoes and in other ways then new, but now common. These are known as "solid cultures."

This was a great advance toward the discovery of disease germs, because by the differences in their behavior or growth on different substances it was possible to separate the species.

The farmer knows that the same soil is not equally good for corn and melons and that a pine tree will flourish where a willow would die. These are at the other extreme in the plant world from the invisible bacteria, but the microscopic forms have their preferences in food and their favorable and unfavorable conditions, as well as their well-known giant brothers.

Method of Study

By finding what they grow on and their behavior in different soils; what they like best to eat; what temperature is most favorable to reproduction; adding to this the knowledge of structure, motion, and form which the microscope reveals, and lastly by chemical analysis of the substances produced by them during growth the species are determined.

These methods have also made possible the cultivation of pure cultures which are highly desirable with all species of commercial value. A pure yeast makes possible a saving of thousands of dollars in the brewing industries alone, and some time, let us hope, the housewife may be able to buy pure yeast for her bread-making.

Bacteria Classed as Plants

It was not until 1850 that these organisms were studied as plants. Dr. Waldo Burnett, a young physician of Boston, suggested this and related theories, which since his death have been proved.

Ten years after, these forms were accepted and classified by botanists.

Founding of the Science

There were many observers and experimenters in the field and about 1881 the science of Bacteriology was founded. To Louis Pasteur must be ascribed the honor of laying its corner-stone, for he first endeavored to cultivate bacteria and yeasts and tried to make pure cultures. Upon the foundation thus laid Robert Koch built the germ theory of disease. He cultivated certain germs and introducing them into the bodies of certain animals was able to produce certain diseases. He then suggested the four rules which still

govern all those who set out on the search for the germ of any particular disease:

Identifying Disease Germs

First, the germ found in any disease must be found in every case of that disease.

Second, this germ must be grown artificially outside the diseased body.

Third, this artificial culture must produce the specific disease in the body of a healthy animal when inoculated into it.

Fourth, the same species found in the original case must be found in the case due to inoculation.

The discovery of the bacillus of Tuberculosis, of Asiatic Cholera, and of Typhoid Fever followed in rapid succession. The last fifteen years have been crowded with searching investigations and numerous brilliant discoveries.

The debt of the world to these discoverers is in importance second only to that which it owes to the bacteria, the molds, and the yeasts. Because the microorganisms have been studied so much from the standpoint of disease, both in food substances and man, their beneficent role is often unappreciated.

SUMMARY

From the preceding pages may be gathered sufficient information to increase the appreciation of the housewife for her many friends among these microscopic plants—bacteria, molds, yeasts—and to put her on her guard against the *many* that under certain conditions, which she can largely control, will spoil her

possessions or the *few* that may bring disease to her family.

Dust as Source of Danger

In general the harmful bacteria and other forms are brought into her house as dust, which through somebody's ignorance or criminal carelessness, is allowed to scatter itself; dust allowed to collect in dark warm places, to be blown about by wind; dust rising from dried expectorated matter on sidewalks, floors or fabrics, from drainage infected soil, possibly carried to the water or food supplies.

It used to be said that dirt was matter in the wrong place. We see now that dangerous dirt is simply a certain kind of matter in the wrong place. It is indeed, *filth*, because this dirt is alive it must not be allowed to grow under any conditions which may bring harm to man.

Summary of Special Terms

A summary of a few special terms explained in the text may serve as a review.

Fermentation from a physiological standpoint is the result of growth in organic matter of a living organized ferment.

Alcoholic fermentation is usually brought about by yeasts. A few bacteria and molds are found to be capable of making weak alcoholic solutions.

Fermentation is applied to the process when the products are desirable or agreeable and non-poisonous.

Putrefaction is fermentation carried so far or under such conditions that the products are undesirable, disagreeable, foul smelling and poisonous.

It is fermentation of substances containing nitrogen —putrid fermentation.

The *products* of these fermentative changes are gases which give odors; acids—lactic, acetic and butyric; weak alcohol, occasionally, and ptomaines which, when poisonous, are called toxines.

When putrefaction has ended and the disagreeable products have disappeared, the residue is usually harmless and inoffensive. If the processes of decomposition go on in an abundance of oxygen, decay is usually reached without offensive products. **Decay**

Sterilization is the removal of all life and is effected by steam, dry heat, chemicals, or filtration.

To remove bacteria, air may be filtered through cotton wool and liquids through unglazed clay or similar substances.

An *antiseptic* retards or prevents growth. A *disinfectant* kills.

Some substances are antiseptic or disinfectant according to their strength or the conditions under which they act. Sunshine is Nature's free disinfectant; light is commonly an antiseptic, and may be a disinfectant. Dryness, excess of moisture, salt, strong acids, the essential oils, soap, hot water, etc., may be antiseptic with some species and disinfectants with others.

Pasteurization, chiefly applied to milk and cream, is a process for killing certain germs which cannot endure the temperature of 155° to 165° F. for twenty

minutes. This destroys the pathogenic and lactic acid bacteria. The milk is then safe, that is, does not carry disease germs, and will keep longer than ordinary milk, but will in time sour because other germs gain access to it.

Properly Pasteurized milk retains the natural flavor and its digestibility is more nearly normal than that of milk which has been sterilized.

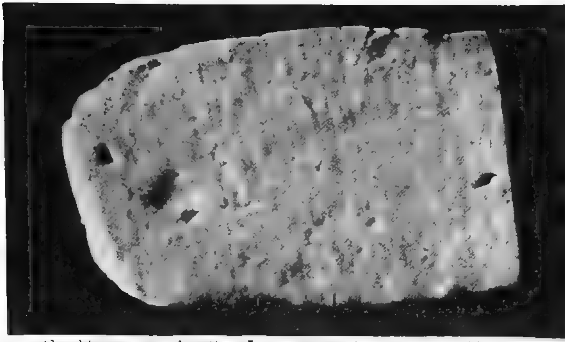
Spores Because certain species of bacteria form *spores* which are very resistant to the ordinary methods of sterilization, it is necessary to repeat the process to ensure success. This repeated boiling for three successive days is known as *Intermittent Sterilization.*

Dust Infected material which would be harmed by thorough sterilization should be destroyed by fire whenever possible. It should never be allowed to become dry and thereby add its infectious matter to dust.

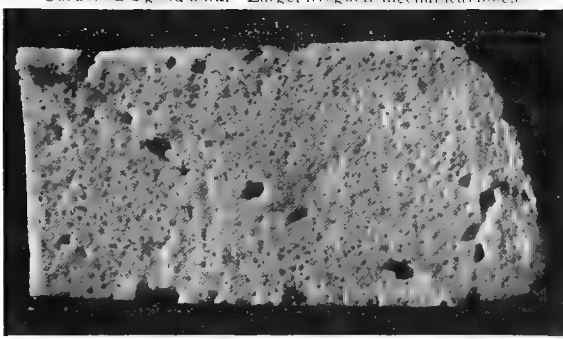
The experiments outlined in the text should be performed as far as possible. The whole lesson will be far more interesting if observation of them precedes the book study.

The questions should stimulate the application of all principles suggested in the text and, wherever possible, be answered after actual observation of practice based on those principles.

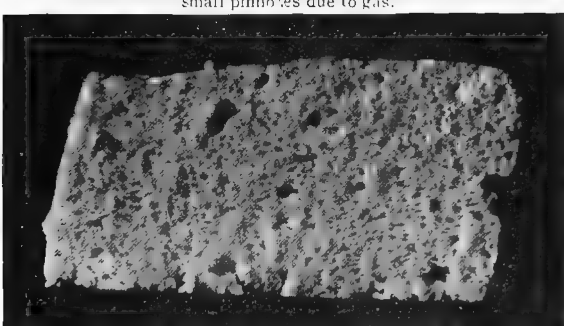
A further knowledge of the whole subject of the micro-organisms included in the science of bacteriology may be gained by reading the small but interesting books named in the bibliography.



Curd from a good milk. Large, irregular mechanical holes



Curd from a tainted milk. Large, irregular mechanical holes; small pinholes due to gas.



Curd from foul milk.

THE WISCONSIN CURD TEST

DIRECTIONS FOR MAKING THE WISCONSIN CURD TEST

J. Q. Emery, Dairy and Food Commissioner, Madison, Wis.

1. Sterilize milk containers so as to destroy all bacteria in vessels. This step is very important and can be done by heating cans in boiling water or steam for not less than one-half hour.

2. Place about one pint of milk in covered jar and heat to about 98 degrees F.

3. Add ten drops of standard rennet extract and mix thoroughly with the milk to quickly coagulate.

4. After coagulation, cut curd fine with case-knife to facilitate separation of whey; leave curd in whey one-half hour to an hour; then drain off whey at frequent intervals until curd is well matted.

5. Incubate curd mass at 98 to 102 degrees F. by immersing jar in warm water. Keep jars covered to retain odors.

6. After 6 to 9 hours incubation, open jar and observe odor; examine curds by cutting the same with sharp knife and observe texture as to presence of pinholes or gas holes. Observe odor

7. Very bad milks will betray presence of gas-producing bacteria by the spongy texture of the curd and of flavor.

8. If more than one sample is tested at the same time, dip knife and thermometer in hot water before each time used.

"Normal milk contains practically no organisms but the straight lactic acid bacteria. These germs produce no gas and no bad odors, but purely lactic acid, and the curd formed therefrom is such as is represented in Figure 1.

"*Milk contaminated by the introduction of dust, dirt, fecal matter, or kept in imperfectly cleaned cans, becomes fouled with gas-producing bacteria that break down the milk sugar and so produce gases and usually undesirable odors.... Therefore milks showing the presence of gas or bad odors in any considerable degree are milks that have been more or less polluted with extraneous organisms or carelessly handled, and as a consequence such milks show a type of curd revealed in Figures 2 and 3.*"—*Dr. H. L. Russell.* (For further directions, see *Farmers' Bulletin*, No. 84.)

HOUSEHOLD BACTERIOLOGY

PART II.

Read Carefully.—Place your name and address on the first sheet of the test. Use a light grade of paper, write on one side of the sheet only, and leave space between answers. Make all experiments possible and read the lesson book a number of times before attempting to answer the questions. Answer every question fully. Do not be too general in statement. Give details wherever they will show your knowledge.

1. What is the objection to a common comb, drinking cup, etc., to promiscuous kissing on the lips, or to spitting on floors or sidewalks?
2. What is an infectious disease?
3. How does a case of typhoid fever show human carelessness and what should always be done to prevent its spread?
4. Through what avenues do germs attack the body?
5. What are some of the means by which the healthy body resists bacterial attacks?
6. What is a toxine? An antitoxine? A phagocyte?
7. What is an antiseptic? A disinfectant? Mention some of each.
8. What disinfectants should the housewife use most freely?
9. Where do disease germs multiply chiefly?
10. In what ways should a study of dust affect the housewife's (a) choice of methods in cleaning, (b)

care of food and clothes, (c) standard in house furnishings, (d) admittance of sunlight and air?

11. Why do dried fruits keep and why do they mold or sour when kept in a damp place?

12. What other antiseptic and disinfecting methods are used to preserve food?

13. Do you know any harmful methods of preserving food from the action of micro-organisms?

14. What objection is there to turning the leaves of books with moistened fingers; wetting envelopes with saliva; putting money and pencils in mouth, etc.?

15. How insure a safe drinking water?

16. What does healthful dusting of a room require?

17. Explain certain conditions which might prevent bread from rising, (b) why it tastes sour, (c) why slack baked bread may mold quickly, (d) why bread should cool rapidly, (e) why warm milk should not be closely covered.

18. How may "June flavored" butter be made in January?

19. What especial precautions are necessary to prevent infection with (a) tuberculosis, (b) typhoid fever, (c) pneumonia?

20. What have you learned from Household Bacteriology which can make better conditions for health to yourself and others?

21. What questions have come to your mind?

Note.—After completing the test, sign your full name.

SUPPLEMENT TO
HOUSEHOLD BACTERIOLOGY

LOUIS PASTEUR, FATHER OF BACTERIOLOGY

EXTRACTS FROM THE INSTRUCTOR'S NOTE BOOK

By S. Maria Elliott,
Simmons College, Boston.

Education is not knowledge alone. It is the development of the individual, and this development should make each person a *force* in the world. No one has a right to keep for himself alone that which another needs. This is pre-eminently true in the line of scientific education. If the material side of life rests upon the principles of natural science, then the knowledge of these principles should, as soon as acquired, be put into practice for our own good. But this alone is selfishness. It gives us power, but power wrongly applied to ignoble uses works havoc. Put any newly acquired knowledge into practical use for the benefit of humanity and the world is improved, while our own lives are enriched. In this way, there is a subtle truth in someone's definition of a scientist: "The man who thinks God's thoughts after Him."

Our school of Home Economics has enrolled among students persons from the Atlantic to the Pacific, from Texas to Canada, and even from far-off Hungary. Some have the schooling of the grammar grades alone, others are in or have passed through colleges and even professional schools. Each has had a different experience from every other and each may learn from his neighbor.

The young girl in the Tennessee mountains may be able to give of her experience to the college professor, while in between and among all grades a common bond of interest has been welded because of our common studies.

Nor does the enrolled student alone gain knowledge from this company of common workers. The instructors are not barred out from this feast of good things. Through the tests, returned from all quarters and by so many persons of varied attainments, standards of living and rich experiences, the instructors are helped to a broader outlook and if, originally they were able to write facts which might serve as guide-posts in daily living, by this time the index finger should assuredly be pointed toward many other helpful paths.

Some one has said that a guide-post is that which tells others to go the way in which you will not walk. This we will not accept, but wherever any guiding finger seems to invite, let us take that path so far at least as it serves our purpose and conditions.

Here are some of the directions in which the students of Bacteriology have walked and others may follow. The following report from Utah may inspire another to do likewise:

"I have tried to put my newly acquired knowledge into practice around the home. For example, I am being more careful of our food products to keep them from dust. I have used a dampened cloth in dusting

and have tried to impress upon my mind in practical ways the principles of action of these three classes of micro-organisms."

Definitions are said not to define, but who can improve upon this one from Kentucky? An infectious disease is "a disease which is contracted from disease germs which make a specialty of this work," and this is as true to facts, although more difficult to read aloud, "Bacteria are infinitely small, intensely energetic, enormously prolific protoplasmic micro-organisms."

A little knowledge is not always a dangerous thing. One woman says, "I thought when I took up the first lesson paper that there was nothing in it I should ever understand, but now it looks so different." She had seen molds through a magnifying glass, and goes on to say, "At any other time I wouldn't have given it a look or thought."

A guide-post which points decidedly in the direction of success reads:

"Thank you more than I can say for the severity of your criticisms on the answers I sent. I liked it and because of it feel more confidence in the whole course."

From Ohio comes this report: "I did find a doctor in our town who . . . . helped me to see things.

"I had an idea that the contents of the Petri dish might be viewed at once. . . . The doctor said "Yes, under the focus it would be as large as the state of Ohio."

Perhaps there are other doctors in other towns who would be glad to help the people "to see things."

Some inquiring minds met difficulties, however, in unexpected places. A student who was "as thirsty after information as ever" was discouraged for the time being by the fact that she had borrowed a microscope from a physician who was not recognized by the "regulars." The city bacteriologist who had promised to furnish "microbes" for examination under said microscope refused "because the Board of Health wouldn't like it," if their cultures were used by a physician "who advertised."

Disinfection needs no further explanation to one who has before her the picture which she describes in this way: "Some years ago while traveling in Mexico we had occasion to pass through a yellow fever district. Fearing that the disease germs might contaminate the oranges peddled at the station by the Mexicans and of which we wished to purchase, a member of the party sterilized the fruit on the outside by dipping them in alcohol and burning it off immediately." That yellow fever is transmitted only by the sting of a certain species of mosquito was not then proved. That there may have been other germs on the fruit is not at all unlikely and while the alcohol bath may have been sufficient, the fire was certainly an ingeniously sure method of sterilization.

A practicing physician among the students says that she "wishes every wife, mother and home-maker could

and would have the advantage of this course of study. Scarcely an hour passes in the day when the practical importance of the lessons is not brought to my mind."

Having gained an insight into the value of the study of chemistry and cleaning, a good Samaritan was anxious to help others and used her influence to have valuable books on such subjects added to the town library.

A wail comes sounding from Georgia: "The housekeeper's life is one round of activity here not only on account of the invisible pests, but those we can see, such as roaches, weevils, etc. These may abound in the north in the eastern part, but we never saw one in Montana." Happy residents of Montana if they have no visible pests, but we have not yet heard that in Montana bacteria are absent.

Mrs. W. finds that strawberries and raspberrries put up uncooked "kept perfectly well so far as (yeast) fermentation was concerned." They molded but only on the surface. When this surface growth was carefully removed, there was no taint present.

From the deck of a houseboat on the Mississippi, in the midst of a cruise of 1,200 miles, comes the statement that there bacteria die, "for even the dirt aboard exercises too much to settle down to idleness and mischief." Fresh air and sunshine—Nature's best disinfectants—should certainly be found on such a vacation trip.

An interested man adds the bit of information which may inspire others to experiment, possibly with success. He says they "have often—in Kansas—tried to preserve figs by canning them but thus far we have failed. Had to preserve them in sugar."

An affirmative answer must certainly be given to the pertinent question: "Do not tooth brushes and wash cloths contain microbes?" They certainly do unless carefully cleaned. The former should occasionally have a bath in borax water. The latter should be well dried daily in the sunshine, if possible, and frequently boiled. There need not and should not be the putrid brush and the sour cloth. The sponge is a very difficult article to keep sweet and clean by common methods. The cloth is certainly much to be preferred from the standpoint of cleanness.

The suggestion is not a bad one that "gloves be worn always while shopping." We may suggest that these gloves might well be washable.

How much healthier our homes would be if we would take the advice of Mrs. W. and "do away with the unnecessary ornaments, merely dust collectors . . . . dispose of them and train the eye to simplicity and healthful emptiness." Along the same line is Miss G's decision: "I have been very much tempted of late to give up my rugs and mattings and use carpets, but I feel now that it would be taking a backward step." It would be better, if it were possible, to do away with the matting which unless the

dust be wiped off from the surface instead of pushed through with the broom, will store much dust underneath.

Miss R. of Illinois has learned that one element in "vital resistance" is to keep one's self in good health, "for then my tonsilitis germs wouldn't have developed." This is her decision after having spent a part of the "Glorious Fourth" in bed in the study of Part II.

One of our students in Michigan has experimented in the sterilization and canning of milk, "using a solution of salt to increase the temperature of the water." She found that by repeating this process three successive days the milk would and did "keep over three years and would have kept indefinitely except for an accident."

An enthusiastic teacher from Canada who "enjoys bacteriology heartily," performed not only the experiments with dust gardens but also numerous others, with most satisfactory results. Her enthusiasm and success may well be passed along for the benefit of others.

One of her best results in growing molds came from a medium of ten per cent prune juice, ten per cent gelatine with eighty per cent water. This was exposed for twenty minutes. In a week there had grown "about twenty mold colonies" and five of bacteria.

Another garden was made like the above, substitut-

ing jelly for the juice. In this the bacteria flourished better than the molds. One of the gardens which she tried was turned to liquid in a week.

She was fortunate to receive from a bacteriologist a pure culture of b. prodigiosus or the "miracle germ." This she planted in the yolk of a hard-boiled egg and in a week it had transformed the yolk to a red mass mingled with much liquid. This was well covered and kept in darkness. She one day found that the hectograph had become a garden of molds and bacteria. Under the right conditions it might have been liquefied.

That childen can be readily taught by observation is shown by a report from the same teacher. A girl insisted that her hands were clean, but a tablespoon of the water in which she washed her *clean* hands when introduced into milk proved an efficient aid in its putrefaction. "The cooking class never forgot to wash their hands."

A class of farmers' daughters found many suggestions for their future care of milk products from various experiments in the cultivation in milk of the different species which turn it sour, putrid, bitter, etc.

Such reports as these should stimulate other teachers to interest, to instruct, to educate, by similar experiments, the children under their care. Anything which will raise the standard of personal cleanness or that of food supplies and general house conditions will tend toward health and greater economy.

And so the tests and personal letters continue to encourage the instructor and open up many a vista of unexpected applications or suggested truths.

The variety of questions show the great need of the study even among those favored with high scholarship as well as among those trained in the thorough but slower school of experience.

When many facts of everyday life, of common observation, are seen to be caused by the growth of omnipresent, invisible plants put into the world as beneficent agents, all life becomes more interesting. Such study should lead away from foolish or ungrounded fear. It should lead to thought and wise action, that the danger spots be prevented or removed; that each do all in his power to protect not only himself but his neighbor.

How strongly it emphasizes the truth from the great poet-philosopher, John Milton:

> "Not to know at large
> Of things remote from use,
> But to know that which
> Before us lies in daily life
> Is the prime wisdom."

SAFEGUARDS OF THE BODY AGAINST DISEASE*

By T. Mitchell Prudden.

Author of "Dust and Its Dangers," "The Story of the Bacteria," etc., etc.

Among the shibboleths of physicians one of the more recent and perhaps the most widely popular today is the word *immunity,* relating to infectious or bacterial disease. The subject holds the floor in the learned societies; it crams the medical books and journals; it lures the solitary workers in the laboratories to long and toilsome quests. At last the layman has begun the query as to what it is all about, and how the new lore which filters through the magazines and newspapers out to him may affect his chance for the healthful threescore years and ten which is his birthright, but of which he is too often ruthlessly deprived.

It is really worth while for everybody to know something about immunity to infectious diseases. For the new doctrines and their practical applications in the workaday world are full of promise for the prevention and cure of the infectious maladies, if only the public will bear its part with intelligence and zeal.

The beginning of the story goes back more than a quarter of a century, when the notion still lingered on that disease was a mysterious something apart from

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the body machine, which with sinister intent took possession of our interiors and battled for our lives; or was a visitation of Providence about which we might not inquire too curiously. Then suddenly we became aware that the soil, air, and water, the surfaces of plants and of our own bodies were swarming with minute, invisible, living beings, some few of which were of the greatest importance to man because they were capable of inciting serious disorders. By a technical device of the laboratory it was soon found possible to secure these invisible plants from their various sources, to separate them one from another, and to cultivate and study them with as much precision as the farmer grows and gathers his various crops.

Of course at first the few harmful members of this newly exploited group of living things cast a shadow over all the rest. And we shuddered as the pioneer in this new domain of science revealed the thousands and tens of thousands of bacteria which we might be swallowing with our glass of water or with our bunch of grapes. But we were soon reassured, for we were told that we had nothing to fear from the rank and file of our humble, newly discovered commensals; that, on the contrary, they were our friends, without which, indeed, the world of life could not long continue. It was only the few which we must avoid if we would steer clear of tuberculosis, pneumonia, diphtheria, typhoid fever, cholera, and a dozen or so others of the uncanny brood of infectious diseases.

These disease-producing germs the bacteriologist soon came to know very well as he grew them in the safe purlieus of his laboratories and found out the various ways in which they were able to work havoc in the delicate mechanism of their earth-neighbor, man. Thus the nature of disease became clearer and the problems of its prevention and cure definite and precise.

BARRIERS OF THE BODY.

The healthy human body is safe-guarded in many effective ways against the entrance and continued life of bacteria and allied organisms. The tough skin affords a most impregnable barrier. The nose and throat and the tubes leading to the lungs are protected with various mechanisms barring the way to many germs which dusty air bears in every breath. The complex chemical processes in our digestive apparatus which convert our food into building material for brain and muscle spell death to the myriads of bacteria with which our uncooked foods are mingled. So. altogether, our life among bacteria, even those of the deadly sort, is usually exposed to little hazard.

But when the best is said, these minute inciters of disease do now and then win their way to the intimate recesses of our bodies, producing serious results. The measure of their ravages is found in the tables of the statisticians, which show that a large proportion of all who die fall victims to these invisible foes, and that, too, at an age when life holds out its brightest promise.

Now let us see how these germs are able to do such serious damage in the living body. This body is made up of a bony framework, around which various tissues and organs are securely and compactly grouped. Each one of these tissues and organs is composed of tiny structures called cells. The cells are little centers of energy stored up from the food we eat and the air we breathe—little laboratories in which chemical processes of the most subtle character are constantly going on. And the life of the body is simply the sum of the more or less independent but co-ordinated lives of the cells which compose it, all acting in harmony. * * *

All these delicate and exquisitely adjusted elements of the body are able to adapt themselves to many vicissitudes without serious disturbance to that sensitive equilibrium which we name health. We may starve them, surfeit them, overwork them, and poison them in the most abandoned fashion. But they sway back to their respective tasks again when our abuse ceases. Unless we go too far; and then they may struggle on, but only in the halting, perverted way which we call disease.

Now, what happens when into this happy family of cells, each nicely adjusted to the others, and all engaged in their various tasks, living bacteria enter, having escaped the outer safeguards?

But before we try to discover this, let us brush away a few cobwebs.

NATURE OF DISEASE

We are so accustomed to personify disease, to think of it as a visitation of malign forces, and to talk of it in terms which belong in the era of superstition and personal devils, that clear notions of disease as a process, not a thing, are rare indeed.

Disease is a perverted process of the living body cells. Bacteria are not the disease; they are only the inciters of disease; nor do they enter the body with sinister intent. If the chances of the hour bring them to rest among the living body cells, and if the conditions are favorable, they begin to grow, but with just as little purpose for good or evil as if they had lodged upon the surface of a rotten turnip.

Many of the bacteria which enter the body do not grow at all. The soil is not to their liking, the environment is not congenial; they die and are hustled off forthwith by certain lowly organized cells—phagocytes we call them—which are the scavengers of the body, and are ever moving here and there to keep the tissues clear and clean. Many bacteria, on the other hand, find in the living body conditions suitable enough, *faute de mieux,* for their simple life processes. But they are speedily devoured and digested by the scavenger cells, or are killed by destructive body juices, and so their tragedies end.

But there is another side to the story when the bacteria which are stranded within the tissues are not to be tolerated in a well-organized cell family. Then trouble begins.

We are likely to think that because bacteria are so small and lowly they cannot do much. But in fact they do a great deal. Their life processes are extremely complex. They are chemical engines of great potency. Out of the food which they assimilate they manufacture a host of subtle poisons, some of which are stored up in their tiny bodies, some set free into the fluids of their hosts. This, in fact, is the front of their offending: the poisons which they elaborate and set free damage the cells.

Sometimes these poisons interfere with the necessary performances of the cells close about them, or they harm them, but not irretrievably; or they may kill them forthwith. Again, they are carried far and wide throughout the body, and the heart is enfeebled, the brain palsied, or fever dominates the scene.

This is the situation, then, when disease-producing bacteria get in among the living body cells and begin to grow, setting free their powerful poisons. It is cell against cell—the well-bred, highly differentiated cell of the body against the crude, prolific spark of matter way down upon her borderland of life, potent only to eat, to multiply, to shed abroad its poison. But the weapons of both the combatants are poisonous. For we should not permit our sympathetic viewpoint to obscure the fact that the fluids and the digestive juices which our own cells elaborate are poisons for bacteria, quite as much as is their stuff for us. It is the old story of the survival of the fittest here in this

little hidden arena. A new environment is established both for the body cells and for the bacteria; and what we dramatize as a battle is really only the attempt of each to adapt itself to the new conditions furnished by the other. The one which adapts itself most readily and completely and quickly wins, by survival.

Infectious diseases, then, are those which are induced by the entrance into the body and the multiplication there of disease-inducing micro-organisms. These are most frequently bacteria; but other lowly beings, such as yeasts and minute animals called protozoa, are sometimes to blame. Each of these infectious diseases has its peculiar characteristics by which physicians recognize it. These features are especially dependent upon the nature of the bacteria which induce them: their ways of growing, the nature of the poisons which they set free, their tenacity of life, etc. But the body cells have their particular vulnerabilities to bacterial poisons, so that in one case it is the nervous system, in another the lungs, in another the digestive apparatus, which especially suffers. Moreover, as one rose is redder than another, or one aromatic plant more pungent than its fellow, so in one case the bacteria which gain access to the body may evolve a more potent poison than in another, and then the disease may be of a more virulent type. So also an individual may at the time of infection be much more susceptible to the ravages of the germ than is usual, and thus the victim of a graver form of disease.

Now we come to immunity. We have seen that, under the usual conditions, the body may be capable of disposing of bacteria or other microbes which enter it by means of its cells or its fluids, so that the invaders can do no harm. This condition is called hereditary immunity—an immunity which is born with us. There is a good deal of difference in animal species in this respect. For many bacteria which are deadly to some of the lower animals are harmless to man, and *vice versa.* So also among the lower animals themselves some are susceptible, some not, to the same species of bacteria.

But there is another phase of immunity which we must look at a little more closely, called acquired immunity. It is a very old observation of the doctors, which has become part of the lore of the layman, that there are infectious diseases in which one attack, if recovered from, protects its victim for a longer or shorter period against a subsequent attack. This is true of smallpox, measles, scarlet fever and in less marked degree of typhoid fever, diphtheria and others.

Here is a form of acquired immunity secured through an experience of the disease itself. In fact, recovery from an infectious disease can take place only by the establishment of an immunity which did not previously exist. But this acquired immunity in some instances suffices only for the exigencies of the hour, while in others it persists for some time, precluding fresh infection.

In order to understand what has happened in the body of a person who has thus acquired immunity through a successfully weathered attack of an infectious disease, it will be necessary for us to look at some very remarkable achievements of the past few years in the prevention and cure of diphtheria. For, though the fact of immunity acquired through disease has been known so long, no one until recently could offer even a plausible conjecture as to the reason for it. Among the earlier of the disease-inducing bacteria to be discovered, some twenty years ago, was the bacillus of diphtheria. This is a little rod-like plant found only in connection with this disease, or in those who have been exposed to it. It is readily cultivated in the laboratory, being very fond of beef tea, in which it is commonly grown.

When a few of these living bacilli from the culture are put beneath the skin of animals, such as rabbits or guinea pigs, a fatal disease is induced, essentially similar to the disease—diphtheria—in man.

In the early days of bacteriology it was believed that, in order to induce artificially the symptoms of an infectious disease, the living germs must be put into the body, and grow there. But it was presently discovered that if you separate all the germs from a culture of the diphtheria bacillus, and introduce the beef tea in which they had grown for some time, into an animal, you can induce the symptoms of the disease just as well as if the germs themselves are put in.

Thus was revealed the significant fact that bacteria may damage the body quite as much by the poisons which they elaborate as by their direct presence.

Now came the next step in the upbuilding of this remarkable series of discoveries. It was found that if this beef tea in which diphtheria bacilli have grown, and which contains the germ-poison, be introduced into an animal, at first in very minute quantities, which are gradually increased in subsequent doses, the animal grows more and more tolerant of the poison, until at last he sustains with indifference amounts which, if given at first, would have been certainly and speedily fatal.

In other words, it was found that by the use of the poison alone of the diphtheria bacillus in increasing doses, an animal can be rendered artificially immune without having suffered from the disease diphtheria at all.

But now a most incredible thing was discovered. It was found that if the blood be drawn from an animal thus rendered artificially immune, and allowed to clot, the yellowish, watery fluid which separates from the solid part, and which we call blood serum, contains something which, when the serum is introduced into the body of another animal, perfectly protects him, not only from the poison of the diphtheria germ, but from the living germ itself; in other words, renders him, too, immune.

ANTITOXIN.

This curious something so potent and so beneficent was called *antitoxin*, because it acts by neutralizing or abolishing the harmful effects of the toxin—that is, the poison of the diphtheria germ.

No chemist has ever been able to separate antitoxin from the blood serum; no man knows its composition; but there it is, the heart, it seems, of the mystery of immunity.

One might think that we had found here some remarkable cure-all in this antitoxin, and that it would prevent or cure other infectious diseases. But this is not the case. It has no more effect in the prevention or cure of other diseases, such as pneumonia, typhoid fever, etc., than so much water. In other words, its action is specific.

The seeker of light in fields relating to medicine is rarely free from the consciousness of urgency in the solution of his problem. So the moment he found that he could protect the lower animals against the ravages of diphtheria which he had artificially induced, he turned at once to the possibility of human protection and cure. And the situation was indeed urgent. No disease was more dreaded than diphtheria, especially in children; the suffering of the victims was pitiful, the mortality great.

The first experiments were made on small animals, but if the serum were to be used in children larger quantities would be required, so sheep and goats were

immunized. But these did not furnish enough. So at last the horse was tried, and was found admirably adapted to the purpose. He lends himself readily to the increasing doses of the potent diphtheria poison; he is easily rendered immune, and he furnishes without especial inconvenience a large quantity of blood. In fact, he makes no more fuss about losing blood than did the old people along in the early part of the last century, who were quite accustomed in the springtime, when they felt a bit heavy and had a little headache, to drop into the nearest barber shop to be bled.

The preparation of diphtheria antitoxin has been brought to a high state of perfection. The horses are first very carefully tested so as to be certain that they have no disease. They are well fed and groomed, and suitably exercised. At first a small amount of the diphtheria toxin is injected beneath the skin. After a few days a larger dose is given, and then at intervals larger and larger quantities, until at last the horse is receiving such an amount in a single dose as if given at first would have sufficed to kill not only one but many horses. He has not had diphtheria at all, but he is now poison-proof—immune.

The animal is then bled from the large vein in the neck, the greatest care being taken, by cleansing of the skin, the use of sterilized instruments, etc., that no outside germ shall get into the blood as it flows. This blood is set aside in a cool place, and presently, as the clot forms, the serum separates in considerable quan-

tity. This is drawn off into flasks and contains the precious life-saving stuff, antitoxin.

Since no one has been able to separate this antitoxic substance from the serum, it is necessary, in order to find out how powerful it is—for its virtue varies with every horse—to have recourse to quite unusual methods. It cannot be weighed as the druggist weighs rhubarb or camphor. But as its value depends upon its powers to neutralize the action of the diphtheria poison in living animals, the test of its strength must be made on these. Guinea pigs are usually employed. It is thus learned how much of the antitoxin to be tested is necessary to save the life of the animal which has received a fatal dose of the diphtheria poison.

The amount necessary for the protection of a human being is larger in such proportion as his weight is greater than that of the guinea pig. The saving power of each specimen of antitoxic horse serum having been thus determined, it is carefully tested to see that no contamination has taken place, then it is divided into the proper doses, each in a small sealed bottle, and sent out upon its mission.

This antitoxin is not effective if given by the mouth, as many drugs are; but it is introduced beneath the skin by a small syringe, and is speedily absorbed into the body fluids.

Now, what has been accomplished by the use of this new and curious form of medicine? The mortality

from diphtheria, taking the results the world over and in a general way, has been reduced more than 50 per cent, and, under the most favorable conditions, full 75 per cent. I need not dwell upon the significance of this beneficent result in the saving of life and in the relief of suffering.

But there is another way in which diphtheria antitoxin has been of the greatest value; that is, in the prevention of the disease among those who have been exposed to infection in families, schools, and other public institutions. Under these conditions an injection of the antitoxin beneath the skin has been the means of warding off an attack of the disease in groups of persons, some of whom without it must inevitably have

We should be most ungrateful if we failed to recognize the importance of this new relationship which has been established between ourselves and our old and ever-useful friend, the horse. We make him manufacture for us in the department of his interior that protective stuff which we could otherwise secure only by ourselves sustaining an attack of diphtheria, and this, too, with the chances against success.

We are now prepared to inquire how this curious antitoxin acts in the body to produce these truly marvelous effects. Has the body kept secreted all through these years of evolution some special mechanism, or some chemical potency, by which all of a sudden it can protect itself against so subtle and so special a poison as this roving bacillus? And if so, do we keep

on hand in our mysterious insides the latent power of protection against all the special forms of disease-producing bacteria which wander the earth? How does it fit into physiology? Or can we indeed create new protective powers in the stress of such varied accidents as new infections involve?

We have seen that the diphtheria bacillus produces its deadly effects through a poison which it sets free as it grows in the body. In order to understand how this poison is rendered harmless, we must know how it damages the delicate body cells. So we must go back to the cell for a moment. These cells in the living body sit in their respective places, and as the nutrient fluids pass and bathe them, each of them being a powerful little chemical factory, they seize upon whatever nutrient molecules they require, and out of these build up such new substances as they need in their business, whether this be self-nutrition, or the storage of energy, or the furnishing of special life-stuff for their neighbors. So each cell is armed with this power of forming chemical union with the food.

But suppose something comes along in the body fluids with which the cell can and does form the same sort of chemical union, but which is not a food; on the contrary, damages the cell—that is, is poisonous or toxic for it. The cell suffers, of course—first, by the direct damage, and, second, by the loss of its food-securing capacity. The latter it has used up in uniting with the poison.

Now, the cell—so runs the theory—finding itself deprived of its food, produces a new and increased amount of this food-seizing substance. In fact, in accordance with a well-known law in pathology, it produces such a surplus of this substance that it is cast off into the body fluid.

But this food-seizing substance, now produced in superabundance and cast off, is still capable of uniting with the poison which is circulating in the body fluids. This it does, and as molecule by molecule the poison forms the new chemical union it is neutralized and so prevented from coming in contact with the cells, where alone it can do harm. This is antitoxic immunity.

Now, if more of this stuff is given off by the cells in the emergency than is necessary to render all the poison harmless, the excess in the body fluid remains there as unused antitoxin. This is the condition of the immuned horse. His cells have produced more antitoxin than is necessary to protect himself, and we draw off some of it in the blood and use it to save the child.

Thus we see that this curious protective process is not an incredible anomaly, but that the body cells have availed themselves in an emergency as protective agencies of those capacities which under normal conditions they use in the assimilation of their food.

This power of the body to protect itself against the poisonous products of bacterial life may be exerted

in a similar way in the presence of other poisons. Thus certain poisonous vegetable extracts and the venom of snakes may be used to secure artificial immunity in the horse, with the development of antitoxin. In countries where venomous reptiles abound the loss of life from their bites is sometimes very great; for example, in India, where the great cobra slays many victims. An antitoxin for snake poison is now made which is most effective against the bites of the cobra and several other venomous serpents. It is called antivenin. Its efficiency for rattlesnake bites has been claimed, but recent studies have thrown some doubt upon this point.

Of course as soon as this remarkable diphtheria antitoxin was discovered the eager workers in the field of preventive medicine at once concluded that we were at the dawn of a new day. For if we can so effectively control the ravages of diphtheria, why not of the other bacterial diseases? So everybody set to work to discover new antitoxic sera—of pneumonia, tuberculosis, plague, typhoid fever, cholera and various forms of blood poisoning, the bacterial excitants of which were already known.

But, unfortunately, these efforts, pursued with the utmost zeal and persistence the world over, have thus far met with very little success. Antitoxic sera for tetanus, or lockjaw, and for some forms of blood poisoning, have seemed to be measurably useful. But, for the most part, the attempts have failed, except in

the daily newspaper, for which the discovery overnight of a new "serum" seems to furnish an item of perpetual interest.

The reasons for this failure are in part evident to experts in this field, in part are still very obscure, and are too technical to be entered upon here. But the eager and toilsome search goes on with such inspiration as is ever his who deals with these urgent problems of life and death, and at any moment the key to the riddle may lie in our hands.

It would be interesting, did the scope of this article permit, to look at the means by which the body protects itself against infection, not by neutralization of poisons, but by the actual destruction of the poison producers—the bacteria themselves. Suffice it to say that here also, in this bacteria-destroying phase of immunity—*germicidal immunity,* it is called—the body does not command new forces or mechanisms, but makes use of those which are maintained for its daily service, but which in the emergency it wields to new ends and with exalted energy.

OTHER METHODS OF PROTECTION.

When it was found that it was not possible at once to secure antitoxic sera for other infectious diseases in the way which had been so successful with diphtheria, the attempt was made to obtain protection in some other way. The leading idea in these researches was to find a method of adapting man to pathogenic germs without exposing him in the process to the

risks of the disease. Some bacteria seem to produce their harmful effects not so much by the poisons which they set free as by something stored up in the bodies of the germs themselves. But if the living germs are put into the body, they may cause the disease, and the very thing to be guarded against might thus be precipitated.

So the attempt was made to avoid this risk by killing the germs by heat and then injecting these dead organisms beneath the skin of the person to be protected. This method has been practiced on a large scale in some countries with the typhoid fever bacillus and with the bacillus of the plague. While some measure of protection seems to have been secured in this way, the method has not been very generally adopted.

There are two other forms of artificially induced immunity which we must consider briefly, since they belong among the greatest life-saving agencies at our command today. I refer to vaccination for protection against smallpox and the preventive inoculations for rabies or hydrophobia.

VACCINATION

First, vaccination to prevent smallpox. If the good Dr. Jenner, who more than a hundred years ago did some excellent observing and some clear thinking about what he saw, and found out how to prevent smallpox, could listen to our up-to-date talk about bacteria, microbes, toxins and antitoxins, and various phases of immunity, he would not understand a word

of it. But, just the same, he led the way to the practical banishment through artificial immunity of one of the greatest and most dreaded scourges of man.

It was known in Jenner's time that those who milked cows having sores upon the udder, due to a local affection called cowpox, often acquired similar sores upon their hands. These soon healed, involving only a slight illness. But such persons had become partially or wholly immune to the more serious disease of man, smallpox.

Jenner studied this subject carefully and came to the conclusion that artificial inoculation with a very small portion of material taken from such cattle might be practiced on a large scale with beneficent results. In spite of much opposition he urged his views, which were gradually accepted, until at last the method has become almost universal in civilized communities.

Large and carefully managed establishments are now devoted to the preparation of the virus, as it is called, by which artificial immunity to smallpox is secured. The slight affection of animals—calves—from which the virus is taken is called *vaccinia*, while the disease corresponding to it in man, smallpox, is called *variola*.

The method now practiced on the large scale is very simple. Healthy calves are carefully cleansed and kept in clean, airy stalls. The belly is shaved and most scrupulously freed from all possible sources of contamination. Into this clean surface, slightly scarified,

is rubbed some of the virus secured from previous cases. After a few days this surface furnishes a yellowish, watery material which contains the protective stuff. This is gathered and mixed with glycerine, and, after careful tests of its purity, is distributed to physicians in small sealed glass tubes. This virus rubbed on to a scratched surface of the human skin induces a slight sore, sometimes accompanied by a little malaise, and then heals.

By this process the liability to smallpox is very greatly diminished, but the protection is reduced as time passes, so that revaccination is necessary if the fullest protection is to be secured.

It is certain that smallpox is an infectious disease induced by some form of micro-organism. But the exact character of this is still unknown. Attempts to cultivate it have thus far failed. It appears that the unknown organism suffers diminution in virulence by passing through the body of the relatively insusceptible calf, and in this condition, while incapable of inciting smallpox in man, is still potent to establish immunity.

A good deal of opposition has developed here and there to vaccination even in recent times. This has been based partly upon the fear lest foreign and noxious material should be introduced into the body along with the virus. But if it be carefully prepared, this fear is groundless. While accidents are not impossible, the ill effects which now and then appear are

usually due to the handling or rubbing of the little wound by dirty persons, against the warning of the physician.

Largely as the result of this form of preventive inoculation, smallpox is no longer to be seriously dreaded. In fact, in the graphic charts which the statisticians make out to show the relative frequency of various diseases, the lines showing smallpox are so short that you can hardly see them; while it is those representing tuberculosis, pneumonia and other diseases of the respiratory system which stretch in most disquieting fashion across the page.

HYDROPHOBIA

Rabies, or hydrophobia, is one of the most dreaded of human maladies, and one whose victims in former times no medical skill could save. It is an infectious disease, though the micro-organism inducing it is still undiscovered. Hydrophobia is commonly acquired by man through the bites of rabic animals, in this country most frequently the dog. The unknown infectious agent is present in the saliva of affected animals. It travels along the nerve trunks from the site of the bite to the central nervous system, where it especially concentrates itself.

Pasteur, the great master in the solution of knotty problems relating to bacteria and immunity, spent many toilsome and harassing years in the study of the rabic virus and in attempts to devise an effective method of protection. He found at last that, although he could not isolate the microbe, he could transmit

the disease from animal to animal by inoculating into the nervous system of the well animal a tiny portion of nerve tissue from one which had succumbed. The inoculated animals invariably died at a fixed period.

After a long series of studies which we cannot here review, he discovered that if the spinal cord of one of the inoculated animals (rabbits) which had died be dried in a clean place, it gradually lost its virulence, so that whereas at first it invariably killed in seven days, day by day it lost its power, so that after drying for fourteen days it was quite inert. Given thus a virus ranging gradually from the very feeble up to the strongest, he saw the possibility of gradually accustoming the body to the stuff, so that at last it would resist the very strongest.

This was tried on dogs, and it was found that after this gradual adaptation to the virus they became at last wholly indifferent to the bites of mad dogs or the artificial inoculation of the strongest virus. The principle was finally applied to man, with the most remarkable and satisfactory results.

Rabies is peculiar in that a long period usually elapses between the bite of a rabic animal and the development of symptoms. This period, called the incubation period, is in man on the average from thirty to forty days; so that if the preventive treatment be instituted without undue delay, there is usually time for the adaptation of the subject to the artificial virus. This accomplished, the disease does not occur.

At each laborotary where the treatment for the prevention of rabies is carried on, this material of varying degrees of potency is kept constantly ready, so that as soon as possible after a bite from a supposed rabic animal the treatment may be started. The operation is a simple subcutaneous injection, resulting usually only in a slight or temporary local soreness. The whole affair is completed within two weeks, when all apprehension may be dismissed. No untoward effects follow the treatment.

The mortality from hydrophobia before the day of preventive inoculation was about 16 per cent. Through this treatment it has been reduced to about two-tenths

The methods of securing artificial immunity to infectious diseases, which we have so hastily surveyed, widely different as the details may be, all seem to depend upon the same wonderful power of the body cells to adapt themselves to harmful conditions by the use to new ends of the old physiological capacities.

The task of the investigator centers largely in discovering the ways in which the body cells may be educated to their new responsibilities with safety and despatch.

We seem to be just at the dawn of discovery in this newly opened field, and the outlook is of the highest promise for the relief of suffering and the prolongation of life.

The various preventive means already devised are in the hands of experts and require the greatest care

on the part of those who make the preparations and skill and judgment in those who advise and administer them. With these things "the man in the street" has nothing to do. But it is for him to see to it that no fad or ism, no false guides, nor ignorance, nor indifference shall hold him from seeking and following wise medical counsel in the face of any of the maladies from which artificial immunity may be secured today. Here ignorance is folly, indifference, crime.

On the other hand, it should not be forgotten that underlying all these protective measures is the living body machine, which each controls for himself. If, through the various phases of unwholesome living so largely in evidence today, the machine is lacking in vigor, then by so much are the chances of recovery lessened when the shadow of disease falls across our path.

Not too much work nor too much play; not too much food and drink, but enough; good air and intelligent cleanliness in houses, assembly places and public conveyances—if these conditions be fulfilled in such way and measure as the hygiene and sanitation of the day demand, we shall go far to establish our birthright to threescore years and ten. And our immunity to infectious disease, whether we brought it into the world with us, or achieve it under the ministrations of the physicians, will most closely confirm the promise of science.

BIBLIOGRAPHY

Bacteria, Yeasts, and Molds in the Home, by H W. Conn. ($1.00, postage 10c)

The Story of Germ Life, by H. W. Conn. (35c., postage 6c.)

Dust and Its Dangers, by T. Mitchell Prudden. (75c., postage 6c)

The Story of the Bacteria, by T. Mitchell Prudden. (75c., postage 6c.)

Drinking Water and Ice Supples, by T. Mitchell Prudden. (75c., postage 6c.)

Our Secret Friends and Foes, by Percy Frankland ($1.25, postage 12c.)

Bacteria, by George Newman. ($2.00, postage 18c.)

Bacteria and Their Products, by G. S. Woodhead. ($1.50, postage 14c.)

Clean Milk, by S. D. Belcher. ($1.00, postage 10c.)

Note: The above books may be borrowed by members of the School for the cost of postage.

For Advanced Reading

A Laboratory Guide in Elementary Bacteriology, by Wm. Dodge Frost. ($2.50.)

Bacteriology and the Public Health, by George Newman. ($5.00.)

Immunity in Infectious Diseases, by Metchnikoff. ($5.25.)

Technical Mycology, by Dr. Franz Lafar, 2 vols. ($8.00.)

Micro-örganisms and Fermentation, by Alfred Jörgensen. ($5.00.)

Government Bulletins

Free of the Department of Agriculture, Washington, D. C.

FARMERS' BULLETINS

No. 29 Souring of Milk and other Changes in Milk Products.
No. 42 Facts about Milk (revised).
No. 43 Sewage Disposal on the Farm and the Protection of Drinking Water.
No. 57 Butter Making on the Farm.
No. 63 Care of Milk on the Farm
No. 73 Experiment Station Work — IV, Pure Water.
No. 84 Experiment Station Work — VII, Cured Test for Clean Milk.
No. 92 Experiment Station Work — IX, Pasteurization in Butter Making, etc.
No 107 Experiment Station Work — XIII, Ropy Milk and Cream.
No. 124 Experiment Station Work — XVII, Soil Inoculation, Distilled Drinking Water.
No. 155 How Insects Affect Health in Rural Districts.
No. 162 Experiment Station Work — XXI, Purifying Milk by Centrifugal Separation.
No. 166 Cheese Making on the Farm.
No. 175 Home Manufacture and Use of Unfermented Grape Juice.
No. 210 Experiment Station Work — XXVII, The Covered Milk Pail.
No. 214 Beneficial Bacteria for Leguminous Crops.
No. 227 Experiment Station Work — XXX, Clean Milk.
No. 233 Experiment Station Work — XXXI, Cider Vinegar.

No. 240 Inoculation of Legumes.
No. 241 Butter Making on the Farm.
No. 262 Experiment Station Work — XXXVI, Water for Table Use. Canning by Intermittent Sterilization.

CIRCULARS OF BUREAU OF ANIMAL INDUSTRY

No. 1 Directions for Pasteurizing Milk.
No. 19 Factory Cheese and How it is Made.
No. 52 A Chemical Examination of Various Tubercle Bacilli.
No. 57 Invisible Microörganisms.
No. 70 Tuberculosis of Cattle.
No. 83 Danger of Infection with Tuberculosis by Different kinds of Exposure.
No. 91 Bacillus Microphorus and its Economic Importance.

REPRINTS FROM YEAR BOOKS

No. 192 Rabies: Its Cause, Frequency, and Treatment (1900).
No. 221 The Use and Abuse of Food Preservatives (1900).
No. 262 The Contamination of Public Water Supplies, by Algae (1902).
Bacteria and the Nitrogen Problem (1902).

DON'T ALLOW FLIES IN YOUR HOUSE.
DON'T PERMIT THEM NEAR YOUR FOOD — ESPECIALLY MILK
DON'T BUY FOODSTUFFS WHERE FLIES ARE TOLERATED.
DON'T EAT WHERE FLIES HAVE ACCESS TO THE FOOD.

Flies are the most dangerous insects known to man

Flies are the filthiest of all vermin They are born in filth live on filth and carry filth around with them They are maggots before they are flies

Flies are known to be carriers of millions of death-dealing disease germs They leave some of these germs wherever they alight

Flies may infect the food you eat They come to your kitchen or to your dining table fresh from the privy vault, from the garbage box from the manure pile from the cuspidor, from decaying animal or vegetable matter or from the contagious sick room with this sort of filth on their feet and in their bodies, and they deposit it on your food, and YOU DO swallow filth from privy vaults, etc., etc., if you eat food that has come in contact with flies

Flies may infect you with tuberculosis, typhoid fever, scarlet fever, diphtheria, and other infectious diseases. They have the habit of feasting on tuberculosis sputum and other discharges of those sick with infectious diseases, and then going direct to your food, to your drink, to the lips of your sleeping child, or perhaps to a small open wound on your hands or face When germs are deposited in milk they multiply very fast therefore milk should never be exposed to flies

What To Do To Get Rid of Flies.

Screen your windows and doors. Do it early before fly time and keep screens up until snow falls.

Screen all food, especially milk. Do not eat food that has been in contact with flies

Screen the baby's bed and keep flies away from the baby's bottle, the baby's food and the baby's "comforter"

Keep flies away from the sick, especially those ill with typhoid fever, scarlet fever, diphtheria and tuberculosis Screen the patient's bed Kill every fly that enters the sick room Immediately disinfect and dispose of all discharges

Catch the flies as fast as they appear Use liquid poisons sticky fly papers and traps.

Place this fly poison in saucers throughout the house. Two teaspoonfuls of formaldehyde in a pint of water sweetened with sugar

To quickly clear rooms of flies, burn pyrethrum powder. Sprinkle the powder on live coals carried on a metal shovel The fumes cause flies to fall in a stunned condition. They must then be swept up and destroyed. Best results are obtained by darkening the room allowing only ray of light to enter at edge of window shade. Flies, in attempting to escape the fumes, will seek ray of light at windows This simplifies their collection

Eliminate the Breeding Places of Flies.

Flies breed in filth

Allow no filth or decaying matter of any kind to accumulate on or near your premises

Sprinkle kerosene over garbage and contents of privy vaults. Keep garbage receptacles tightly covered clean the cans every day, the boxes at least every week. Keep the ground around garbage boxes clean.

Keep manure in screened pit or tightly covered vault MANURE SHOULD BE REMOVED EVERY WEEK, AT LEAST.

Burn all refuse — such as old bedding, paper straw, etc

Pour kerosene into the drains Keep sewerage system in good order repair all leaks immediately.

Clean cuspidors every day. Keep 5 per cent solution of carbolic acid in them all the time. Get rid of sawdust boxes used as cuspidors - they're insanitary

Permit no dirt to accumulate in corners behind doors, back of radiators, under stoves, etc

FLIES IN THE HOME INDICATE A CARELESS HOUSEKEEPER.
REMEMBER NO DIRT — NO FLIES

SUPPLEMENTAL PROGRAM ARRANGED FOR CLASS STUDY ON

HOUSEHOLD BACTERIOLOGY

By S. Maria Elliott, Simmons College, Boston

MEETING I

(Study pages 1 – 14)

Dust and Dust Gardens

The growth of a dust garden will impress this whole subject much more vividly than any amount of reading. Each member should plant and watch the growth of at least one garden. One person might prepare and sterilize the nutrient gelatine for the class, distributing in sterilized wide-mouth vials or test tubes about two teaspoonfuls to each. Each member should sterilize the dish or dishes, melt the gelatine by placing the tube in cold water and then heating it, pour into the Petri dish, cover, cool, and plant.

(If not to be had locally, a dozen Petri dishes may be obtained through the School for $1.90, a half a dozen for $1.00, not including express charges. Money will be refunded for those returned.)

Arrange as varied conditions for experiment as possible. The following list is only suggestive of interesting sources and methods of treatment:

(a) After sweeping a carpeted room with a dry broom, expose five minutes, keep at room temperature, but not in direct sunlight.

(b) Same as above but kept in a refrigerator.

(c) Same as "a" but shut up in a box.

(d) Dig out from some corner of stairway or room the dirt which was overlooked in cleaning. Pulverize this and scatter a little over the jelly. Keep in any condition desired.

(e) Let a fly walk over the media.

(f) Touch the fingers to the jelly after handling dusty books.
(g) Touch the jelly with pieces of money or with a bill.
(h) Take any one of the planted plates. Lay over one-half of the jelly a thick piece of black paper or cloth. Put the dish in direct sunlight.
(i) Scrape a bit of the deposit from the teeth and touch it to several places on the jelly.
(j) Rub a few drops of boiled water in the palm of the hand and mix it with the liquefied media.
(k) Take one of the dishes to a public gathering and open it for five minutes or more when the audience has been seated for a short time.

Require that each experimenter keep a daily record of every change, however minute. At the next meeting let these experiments be reported, the gardens shown, and as many conclusions drawn as may be feasible, leaving their truth or falsity to be proved by further study.

References: Dust and Its Dangers, by T. M. Prudden. Chapters I, II, III, IV. (75c., postage 6c.)
Our Secret Friends and Foes, by Percy F. Frankland. Chapters I–III. ($1.25, postage 12c.)

MEETING II

(Study pages 17–32)

Character of Bacteria

If possible, get some physician to show bacteria under a microscope.

(a) Take some from the dust gardens already planted.
(b) Take a drop of water from a vase of flowers which has stood unchanged for a week.

Put a wisp of hay in warm water, let it stand for twenty-four hours in a warm place, then examine with the microscope a drop of the brownish infusion.

Make any experiments possible from "Bacteria, Yeasts, and Molds," by H. W. Conn, pages 269–285.

Perhaps the physician may be able to show some pathogenic germs.

References: The Story of Germ Life, by H. W. Conn. Chapter I. (35c., postage 6c.)
Bacteria, Yeasts, and Molds, by H. W. Conn. Chapters VIII, IX. ($1.00, postage 10c.)
The Story of the Bacteria, by T. M. Prudden Chapters I, II, III, and IV. (75c., postage 6c.)

MEETING III

(Study pages 33–46)

Molds and Yeasts

(a) Show a sample of moldy bread, cheese, shoe, mildew from clothes.
(b) Generate carbon dioxide as shown on page 43.
(c) Examine both yeasts and molds under microscope or hand magnifying glass.
(d) Make a small portion of "milk emptins" as described on page 6. Note changes which occur during one week.
(e) Mix some bread dough. Put a part in the ice-chest, keep an equal part at about 70° F. and a third at a much higher temperature, 100° F. or over. Compare results at the end of six, twelve, and twenty hours.
(f) Pour boiling water on a small bit of yeast cake and use this solution for mixing another portion of dough which is to be kept at about 70° F.

References: Bacteria, Yeasts, and Molds, by H W. Conn. Chapter II, pages 12–24, and Chapters III, IV, V, and VI. ($1.00, postage 10c.)

(Select a composite set of answers to Test Questions on Part I and send them to the School for correction. Report on the supplemental work done and the results of the experiments.)

MEETING IV

(Study pages 49–62)

Work of Bacteria

Fermentation and putrefaction.

References: The Story of Germ Life, by H. W. Conn. Chapters II. III, IV. (35c., postage 6c.)
Bacteria, Yeasts, and Molds, by H. W. Conn. Chapters IX–XIII. ($1.00, postage 10c)
Our Secret Friends and Foes, by Percy F. Frankland. Chapters IV, V. ($1.25, postage 12c.)
See also U. S. Government Bulletins.

MEETING V

(Study pages 63–96.)

Harmful Dust Plants

(a) Perform the experiments outlined on pages 64–66.

(b) Boil a pint of milk 15 minutes. Pour into bottle which has been boiled in water the same time. Close with cork which has also been boiled.

Pasteurize an equal portion (bottle and cork as above). Keep this at about 155° F. for 15 minutes. Keep both under same conditions. Test each day with blue litmus paper. Note first trace of acid. Test by smell and note first signs of coagulation. Compare results in time. When opening, expose as little as possible to dust. Do not lay cork down or touch lower part with fingers. If cork is handled or exposed to more dust, boil again. While cork is out, lay a clean wet cloth over mouth of bottle.

References: Dust and Its Dangers, by T. M. Prudden. Chapters VI, VII, VIII. (75c., postage 6c.)
The Story of Germ Life, by H. W. Conn Chapters V, VI. (35c., postage 6c.)

Bacteria, Yeasts, and Molds, by H. W. Conn. Chapters XIV, XV. ($1.00, postage 10c.)
Our Secret Friends and Foes, by Percy F. Frankland, Chapter VI. ($1.25, postage 12c.)
The Story of the Bacteria, by T. M. Prudden. Chapters V – XIII. (75c., postage 6c.)

MEETING VI

(Study pages 96 – 116)

Household Applications

(a) Make out a list on paper of the most common and most harmful dust gardens occurring in the household — the dishcloth, refrigerator, waste-pipe, damp floor-mop, or any cloths put away in dark closets, uncleaned bread boxes, etc.

(b) Expose small portions of bread, cheese, sauces, meat, milk to dusty air. Keep in warm, dark places and note time, character, appearance of changes.

(c) Consider the care of hands, teeth, all parts of the body; house, sidewalks, backyard, garbage barrels, etc., from bacteriological standpoint.

References: Dust and Its Dangers, by T. M. Prudden. Chapters V, IX, XI, XII. (75c., postage 6c.)
Bacteria, Yeasts, and Molds, by H. W. Conn. Chapter II, pages 24–31; Chapters VII, XIV. ($1.00, postage 10c.)
Water and Ice, by T. M. Prudden. (75c., postage 6c.)

(Select answers to Test Questions on Part II. Report on supplemental work and experiments.)

THE BACTERIA SCARE *

By Mary Hinman Able

There is a rare form of insanity known to physicians in which the patient is forever washing his hands and fancying that he is polluted by every contact. A few years ago when we were at the beginning of our fight against tuberculosis, typhoid fever and other diseases that may be carried in various forms of filth, it seemed that a mild epidemic of this form of insanity would be a blessing to any community, as it would insure the clean hands which must be insisted on if we are to have clean food. However, when one sees the wholesale and often unwarranted application of a little knowledge of bacteria to every phase of life one is thankful for all the existing sanity and desirous of its extension. For in the wake of every reform is found the trail of the extremist. The Journal of the American Medical Association calls attention in a late issue to certain statements in a book entitled Good Health and How We Won It, by Mr. Upton Sinclair and Mr. Michael Williams. It seems that the writers recovered their health by decreasing the amount of their food and omitting meat entirely. We do not hear as a reason that these gentlemen felt that they were approaching middle life when just this change in the diet has frequently been recommended by physicians, though for reasons unconnected with bacteria; they say they have abandoned eating of meat because of the great numbers of bacteria that it contains, there being, it is claimed, hundreds of millions of bacteria in different cuts of beef steak and several varieties of sausage.

* From the *Journal of Home Economics.*

It is said that every form of error may be traced to faulty logic; here the trouble seems to be that the premises are false. "Meat contains many bacteria. All bacteria are harmful, therefore, etc." The investigators do not state the kind of bacteria nor the way they came to be present in the meat, and evidently they believe that meat in and of itself is naturally and normally laden with these minute forms of life. As a matter of fact though results of a different character have been reported not infrequently, carefully made and carefully controlled laboratory work with all precautions taken has shown that the raw flesh of healthy animals is stirile, and only in certain animal diseases is bacterial life present in the tissues.

All living things, both plants and animals, are subject to bacterial diseases, but if bacteria are found on raw or cooked meat from healthy animals it is safe to say that they were lodged there by passing air currents just as they are lodged on any other food thus exposed. Rightly interpréted then, the laboratory experiments indicate that all foods should be protected from accidental contamination by bacteria, as harmful species may be present among them, not that meat should be excluded from the diet because bacteria happen to be found on it.

A very few bacteria, not more than 50 or 60 species, are known to be harmful, many are known to serve a useful function and it is thought that some varieties may even prove to be necessary to the digestive processes. The intestinal tract of man swarms with bacteria, and the experimenter has never been able to free from bacteria the digestive tract of an animal that has once lived under normal conditions. Of the foods we eat there are absolutely none free from bacteria, if we except cooked food

fresh from the fire. The purest milk obtainable for the table contains thousands of bacteria to the cubic centimeter, while commercial milk may have many millions. Buttermilk and other forms of acid milk also contain correspondingly large numbers. Many hundreds of these harmless bacteria are known and named, while the harmful or pathogenic bacteria number only a few score. It is these few malevolent microbes that must be avoided, and hence all the precautions we have adopted as to cleanliness in hospital, market, dairy and kitchen. But if life is to be worth living we must learn where these objectionable varieties come from in order to concentrate at the proper place our use of that eternal vigilance which is the price of health.

Here are a few suggestions. Human contact with food is probably the greatest source of danger. If a piece of dry bread fall on the floor of a clean private house the bacteriologist tells us it might be picked up and eaten with impunity. Not so if this bread were to be dropped on the floor of a trolley car, especially in the old days when expectoration was common. The driver's hand which grasps the top of the milk bottle which he delivers may leave bacteria there and the bottle should be washed before the milk is poured out. The diminishing of the number of bacteria in our food by the practice of cleanly habits (and no one of these habits is more important than the thorough washing of the hands before handling and preparing food and before meals) is recommended by all hygienists; but there should be no morbid fear of the consumption of foods that have been the dependence of the race since the dawn of civilization and before, simply because we do not ordinarily eliminate from them every trace of bacterial life.

INDEX

PERSONAL HYGIENE

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CHICAGO

AMERICAN SCHOOL OF HOME ECONOMICS

1912

CONTENTS

EDITOR'S NOTE

Arrangements were originally made to have this series of lessons on Personal Hygiene prepared by Professor Thomas D. Wood of Columbia University. An operation for appendicitis, resulting seriously, compelled him to abandon all work for nearly two years, consequently the preparation of the lessons was turned over to his co-worker, Dr. George L. Meylan, whose manuscript followed after some time. Meanwhile, the whole course had developed in length, breadth, and depth and the work on Personal Hygiene was found to be too elementary and not to fit into its particular niche in the enlarged scheme. As Dr. Meylan could not give the time for revision, he asked to be released from further responsibility of authorship.

After endeavoring in vain to induce half a dozen others to write the book in the time set, the editor was compelled to undertake the difficult task himself, with such assistance as could be obtained. Dr. Meylan's material has been drawn upon, especially in Part I, but the subject-matter has been rearranged and for the most part rewritten. All the up-to-date books on the subject—a meager list—have been consulted, and ideas borrowed freely.

For the latest facts in physiology I have depended mainly on *A Text-Book of Physiology* by Professor William H. Howell of the Johns Hopkins University, *Recent Advances in Physiology and Bio-chemistry*, edited by Leonard Hill, Pawlow's classic book, *The Work of the Digestive Glands*, and the ately published college text-book, *The Human Mechanism*, by Professors Hough and Sedgwick.

I wish to make grateful acknowledgment for help and suggestions given by Mrs. Ellen H. Richards and Miss S. Maria Elliott, to Miss Helen Louise Johnson for assistance in editorial work, and to Dr. Frank W. Allin of Rush Medical College for checking the technical statements in the text.

AMERICAN SCHOOL OF HOME ECONOMICS

CHICAGO

January 1, 1907.

Dear Madam:

As the lessons on Personal Hygiene have been so long delayed, many of our students have about completed their courses. Nearly all the letters received giving the reason for slow progress speak of personal ill health or sickness in the family, and I realize now more clearly than ever before that these lessons should form the keystone in the arch of health which we are trying to build with our course.

I undertook the preparation of these lessons with full recognition of the difficulties of the subject. If I might have had two years instead of two months to write them, the result might have been more satisfactory to me. The words to carry conviction and compel action are hard to find.

Personal health is so necessary,-few things are worth while without it. It is above price and cannot be bought with money--it must be worked for like nearly everything else worth having. Its value is hard to realize until lost and then it may be too late. The tragedies, the sorrows, the heart aches that come from lack of knowledge and lack of self control in the matters of health are beyond reckoning.

I hope these lessons may be only the beginning of your study of personal health. Follow the "Supplemental Program" if possible. In problems of health the application of principles must always be a most personal one. Of course here as elsewhere it is a mistake to look for trouble--to expect things to go wrong. The hypochondriac never fails to find looked for ills. We must live in faith. Nature takes wonderful care of us if we will only give her co-operation.

Put yourself into your answers and give expression to your own ideas. Ask questions freely and so allow me to supplement the lessons. I may not be able to answer all your questions but perhaps can give a little more help. Of course advice in cases of illness cannot be given at "pen and ink distance."

Sincerely yours,

Maurice Le Bosquet

Instructor

Right Living

Live to accomplish something—not merely to exist.

To live means to eat, to work, to sleep, to be amused and refreshed after work.

Eat for satisfying legitimate hunger of the body cells —not only to please the palate.

Sleep for restoration of energy—see to it that such is the result.

Exercise is as essential as sleep—learn what and how much shakes out the dead ashes from the living coals.

Life processes go on best unwatched. "All the world's a stage"—enjoy the play.

Live for a worthy purpose—some incentive, some goal to reach keeps the traveller on the safe road.

Adapt habits to environments, control surroundings as far as possible to the great end—effective life.

Educate the young from the first to value life and health, to find happiness in right living.

Above all, believe that it pays to know the truth and to follow it.

Ellen H. Richards

PERSONAL HYGIENE

Definition

HYGIENE is the technical application of biology and physiology to the problem of health. The old dictionary definition of Hygiene, which stated it to be "that which has to do with the *preservation* and *restoration* of health" has of later years given way to a higher ideal, and we may define it now as "that which has to do with the *preservation* and *improvement* of health."

Most people consider themselves well as long as they are not ill and do not consciously endeavor to better their physical condition, but those who have interpreted anew the definition of hygiene seek the higher ideal.

Value of Health

A most important factor in the study of health is an appreciation of the *value* of health. This means much more than merely to wish one's self well. It involves a realization that the first and most important *duty* is to be well.

The second factor is the willingness to do anything that is necessary to acquire ideal health. Many are willing to be patient, to take time, money and trouble to *regain* the blessing of health once lost; few are found willing to do all this to attain a higher standard.

Economy of Health

The third factor is in a measure involved in the second, but needs to be stated more forcibly. It is the realization that the time and strength and money used for the improvement of health are not taken from greater or more necessary things, but that health is a fundamental necessity. Some do accomplish much in spite of physical limitations and many who seem to be fine physically have never achieved greatness elsewhere. But it remains that to do one's best it is necessary to be one's best.

Personal Responsibility for Health

Finally the personal responsibility for health should be appreciated. Health is the natural condition of the body. The organism is constantly endeavoring to maintain itself in this normal state and it is only when conditions are so unfavorable that the body cannot adjust itself to them that illness results and the organism demands rest for recuperation.

Statistics show that only ten per cent of mankind die from natural causes,—the wearing out of the machine through old age. It is safe to say that poor health and illness result in nine cases out of ten from *ignorance, carelessness,* or *intemperance* of some kind.

Most people have certain notions and theories as to the requirements for personal health, but very few have studied the subject systematically in the light of present-day scientific developments. Knowledge of personal hygiene is not yet considered an essential part of a liberal education.

Few people live up to the knowledge that they have

of healthful living, but a falling short of ideals is common in all lines of human endeavor. What is needed is greater knowledge and *higher ideals*.

Preventable Diseases

Much illness results from carelessness, for all contagious or infectious diseases (communicable diseases) are preventable. As far as known, each case comes from some previous case, near or remote, so that all such illness may be attributed to carelessness and ignorance, chiefly perhaps of those who are ill or their attendants, but often through lack of ordinary precaution on the part of those contracting communicable disease. The body in perfect health is a fortress against the invasion of the germs of disease, but some seemingly trivial weakness may give the germs the chance to develop and affect their dread results.

Intemperance

Intemperance has many forms besides the over indulgence in alcoholic liquors. Intemperance in eating is probably as common and nearly as disastrous. We may be intemperate in work as in play.

Personal Limitations

The individual "strength of constitution" so called, differs greatly, it is true. Each one has his personal limitations and these should be studied, but a certain measure of health is possible for everyone who is willing to work for it, unless the attempt is made too late. Through childhood the mother is chiefly responsible for the health of the child, after which each individual is *alone* responsible for maintaining the degree of health that he has and improving upon it. That a poor

constitution may be improved greatly and oftentimes developed into a vigorous one has been proved repeatedly. A notable example is that of President Roosevelt who when a youth was unpromising physically.

Health and Happiness

But as man is more than animal and has a mental and spiritual life as well as a physical life, these must be considered in any study of right living. As there can be no perfect happiness without physical health, so there can be no perfect physical health without the mental and spiritual health which gives happiness, and further, this higher health depends upon a true philosophy of life, a proper adjustment between work and recreation, some purpose in living, service, ideals.

The problem of right living is always one of adjustment and it is necessary to know as much about the body as possible to make the most perfect adjustment to the ever-increasing complexity of modern life.

In this series of lessons we shall study something of (1) The Human Machine, (2) The Running of the Machine, and (3) Care of the Machine.

THE HUMAN MACHINE

The human body is a living machine in that the function of a machine is simply to convert one kind of energy into another. This is precisely what the body does. Biology is concerned with the origin of this machine, physiology with the running of it.

The facts discovered in connection with the organic cell and protoplasm seem to hold the key to the interpretation of the life phenomena. Life itself is inexplicable. Yet what we believe to be true of the origin of the living machine assists us in the difficult task of properly adjusting this organism to its environment.

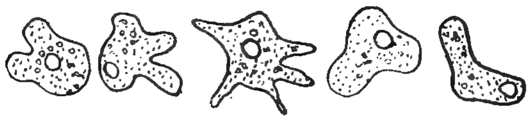
Nature of Life

If we compare a dead body with a living one, we find the form the same, the weight the same; if we analyze them chemically, we still find them the same. Yet we know there is an essential difference between the two and that difference is given by a wonderful something called life. A living body has the property of movement, takes in food and builds it into living tissue, reacts to its surroundings, maintains an even temperature, reproduces itself, and finally dies.

Organisms

All living things from the lowest to the highest forms are called organisms. One of the lowest forms of animal life is a little body found in muddy water, called the amœba. This small organism is barely visible to the naked eye and if looked at under the microscope appears like a tiny round mass of jelly.

But this very small body moves about, takes in food, changes that food into living substance, and grows; it responds if irritated; it reproduces itself, and finally it dies. This tiny mass, therefore, has all the properties of a living organism.



THE AMOEBA, A TYPE OF A UNICELLULAR ORGANISM

Unit Cells

If we cut the amœba into several pieces, we find that each part is like every other part. This represents the simplest possible living thing capable of an independent existence. It is a single cell. The study of the amœba is interesting because the human body is developed from a single cell called an ovum which is very similar to the amœba. The process of development may be divided into three stages.

Development of the Ovum

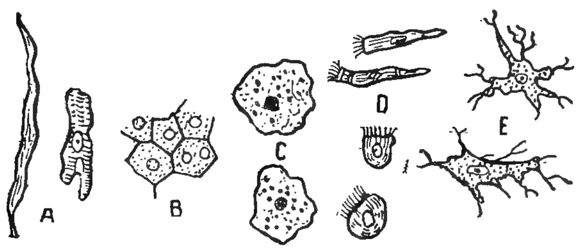
In the first stage the ovum or cell divides into two cells and each again divides into two until there are many cells all alike, which are held together and form a mass something like the little round parts making up a raspberry. Up to this point each cell is like every other cell.

The change that takes place in the second stage has been likened to the transformation of a savage into a civilized man. The savage lives an independent life; he procures his own food, makes his clothes, builds his hut, and fights his own battles. Little by little, one

man finds that he can build huts better than other men and he builds a hut for another man who is a successful hunter, and exchanges the hut for food. In the same way one man is very skillful in making clothes and he makes the clothes for a man who makes very good tools. Gradually differentiation of labor takes place; that is, one man learns to do one thing well and does that only, while other men do the things for which they are best fitted.

Differentiation of Labor

A condition very similar to this division of labor takes place in the second and third stages of the de-



BODY CELLS.
A, Muscle Cells; *B*, Liver Cells; *C*, White Corpuscles; *D*, Ciliated Cells; *E*, Nerve Centers or Cells.

velopment of the full grown man from the mass of similar cells. At the first stage, each cell is like the savage who does everything for himself. As the cells grow and multiply they begin to show some differences and the end of the second stage shows three distinct kinds of cells which may be denoted as the outside, middle, and inside cells.

During the third stage the process of division of labor by differentiation of cells continues and there is developed gradually the final specialized cells, each having some particular work or function to perform. Some are bone cells, some are muscle cells, others liver cells, nerve cells,—every kind of cell necessary to a complete organism.

The Organs A group of one kind of cells doing the same work is called an *organ*, and the body is composed of various organs. The heart, the stomach, the lungs, the muscles, and the brain are all organs, each having its particular and definite work to do in maintaining life.

Returning now to the comparison of the human body to the conditions of modern civilization,—we know that with the far-reaching specialization of the various occupations, the welfare and happiness of the people depend on each class of. workers doing its share. When there is a great strike, as for instance, when all coal miners stop working, homes and factories which must have coal for fuel are much disturbed and suffer greatly. In the same way, if all the bakers or butchers go on strike, much trouble and distress is caused to society.

Inter-relation of the Organs Similar conditions exist in the human body. Each organ has a particular work to do and the well-being of the body as a whole depends upon the proper working of each and all the organs. When all do their work well, we have in the body the condition known as health. When some of the organs are impaired

and their work is poorly done, we have the condition known as disease. It is essential, then, to know the principles underlying the proper working of all the organs in order that we may keep them in a condition favorable to the body as a whole.

Health of the Cells

The health and efficiency of the various cells depend on (1) proper nourishment, (2) functional activity, and (3) free discharge of waste matter. All the organs and functions of the body have a share in supplying these conditions. The organs of digestion and respiration supply the body with nourishment; the organs of elimination carry off waste matter; the muscles furnish the necessary functional activity; the blood serves as a vehicle for nourishment and waste matter, and all the organs are governed by the nervous system.

Health of the Body

We have seen that if any of these organs performs its work inadequately, the condition of health is impossible. The reason that so many people are in the condition of imperfect health is that the human body depends for its health on its environment; that the environment best suited to its needs is one of simple active outdoor life, and that civilization has so modified man's environment that his life is complex, sedentary and indoors. These conditions are unfavorable to perfect health.

Evolution of the Body

It has taken thousands of years of evolution to develop the human organism to its present state—its adaptation to an active outdoor life, but in the last hundred years civilization has brought about such rad-

ical changes in man's environment that it is at present difficult for his body to adapt itself to the new demands. The marked decrease in the amount of muscular exercise, the enormous changes in shelter and food, the great increase in nervous activity, necessitate great modifications in the various functions of the body. That most of the functional disorders common to our city population would be easily remedied by a change to a simple, active, outdoor life, is shown by the marked improvement in health which takes place when a man or woman spends a summer camping out.

Degrees of Vitality

From the standpoint of health, people may be divided into three classes. In the first class are those who possess a large amount of vitality or resistance to disease. They maintain good health under all circumstances—hard work and unhygienic surroundings have no apparent effect upon them.

In the second class are those who are well and strong when living under favorable conditions of work, air, food, exercise and rest, but who fall ready victims to epidemics and easily affected by adverse conditions.

The third class, small in number, includes all persons having inherited or acquired weakness who are incapable of a high degree of health, even when surrounded by the most favorable conditions.

Most people belong to the second class. They thrive when the environment is favorable, but are easily affected by bad air, poor food, overwork, and other external circumstances.

Health, then, may be said to depend on two main factors, (1) the strength, vitality or constitution of the individual, and (2) the environment in which the individual is placed.

Factors in Health

A natural question is: What is constitution and how may it be improved? The constitution or vitality of an adult depends on two things, heredity and nurture. It is a common law of nature that children of healthy parents are much more likely to be strong and vigorous than the children of weak, sickly parents. It has also been demonstrated that children brought up under favorable conditions of air, food, bathing, exercise, rest and play, are likely to grow up healthy and vigorous even with poor inheritance.

Health also depends on the *immediate* influence of environment. A man or woman who has inherited a vigorous constitution from his parents and has been brought up under favorable conditions of life, may ruin his health in a short time by exposing himself to an unhealthy climate, overwork, bad air, poor food, filth, worry or dissipation.

Environment and Care

In these lessons we shall study the important functions of the body and the conditions most favorable to them. In all this we should keep in mind that in our attempt to enhance the influences which improve the health, we are not studying simply to increase the efficiency, usefulness and happiness of the individual but we are building permanently by increasing the vitality of the fathers and mothers of future generations.

STRUCTURE OF THE BODY

The many dissimilar parts of the body, such as bones, muscles, nerves, lungs, etc., upon close examination may be resolved into the elementary structure called tissues. The body, then, is composed of solid tissues and fluids.

Tissues Microscopical examination of any tissue shows that it is composed of the living physiological units called cells and the cells of any tissue are similar in structure and function. These are the fundamental structural elements, and it is by the combination and transformation of these, and material derived from them, that all the tissues, seemingly so different, are formed which make up the structure of the human body.

The bones which give the fixed figure and form as well as support to other organs; the ligaments and cartilage connecting the bones; the muscles which make motion possible; the organs of nutrition, secretion and excretion; the nervous tissue, and that composing the organs of the special senses, are primarily made up of cellular tissue corresponding to the frame-work of any building with its intricate steel, brick, mortar and board formation.

Fluids The fluids are intimately connected with the life of the structure. If they become stagnant or contaminated, trouble ensues. Upon their purity and renewal life depends. These fluids are the blood or circulating medium; the fluids connected with the process of assim-

ilation such as lymph; the digestive juices, as saliva, the gastric, pancreatic; and the excretory fluids.

Divisions of the Body

For purposes of classification the body may be separated into head, trunk and limbs. The head may be sub-divided into skull and face; the trunk into chest or thorax and the belly or abdomen. The arms are sub-divided into upper, fore-arm, wrist and fingers, roughly corresponding with thigh, leg, ankle and toes.

The thorax or chest is separated from the abdomen by a peculiar partly fleshy, partly membranous organ called the diaphragm. The alimentary canal lying in front goes through the diaphragm and is composed of œsophagus, stomach and intestines. The abdomen also contains the kidneys, liver, bladder, pancreas and spleen. The thorax contains the heart and lungs.

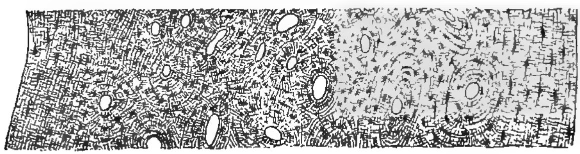
The cavity of the skull connects with the spinal canal. This cavity contains the brain which is continuous with the spinal cord, the brain and spinal cord constituting the cerebro-spinal system.

BONE

Structure of Bone

Bones are made up of osseous tissue which consists essentially of animal matter similar to connective tissue impregnated chiefly with calcium salts which give rigidity. In general, a bone is a hard, tough body, flexible and elastic within narrow limits, but breaking if pressed too far. When a long bone is broken across, it is found not to be a solid mass of ossified tissue, but to contain a cavity filled with a mass of connective tissue, called the medulla or marrow. This

medullar cavity extends through the shaft or bone, but as it reaches a joint becomes sub-divided by bony partitions and shows numerous smaller cavities. The walls of this cavity are seemingly dense, but are traversed by a net work of narrow vessels known as the Haversian canals which have intimate association with the nutrition, hence with formation of the bone.



STRUCTURE OF BONE, SHOWING CANALS AND THE LIVING CELLS (THE BLACK SPOTS)

Kinds of Bones

There are two kinds of bones classified as to their origin: (1) *Membrane* bones developed from fibrous tissue including most of the bones of the head, (2) *Cartilage* bones developed from cartilage, including most of the bones of the skeleton.

The growth of bone takes place largely in two places, at the *epiphyseal* line or cartilage between the shaft and head, and at the outside covering or *periosteum*.

Development of the Bones

In the embryo "centers of ossification" appear in these membranes and cartilages and calcium salts are deposited to form bone. In long bones usually there are three centers of ossification, one for the shaft and one at each end. These grow toward each other but

do not completely unite until the skeleton nears the adult size. Consequently in childhood there is danger of fracture at this line of union since it is cartilage and not fully developed bone.

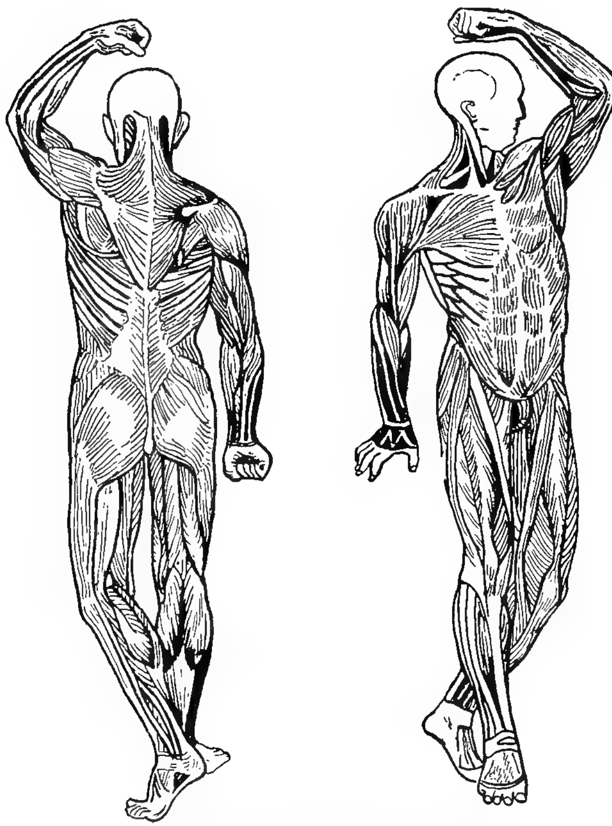
Living Part of Bones

The periosteum is the essential living and growing part, much like the inner bark of a tree. During the growing period especially, new bone is constantly being laid down on the outside, thus increasing the size of the bone, while destruction is going on within, hollowing out the center. In youth the building process exceeds the destruction. In old age the building has nearly ceased and destruction continues until bones become very brittle. When these bones are broken they unite with great difficulty.

MUSCLE

Bones, cartilage and connective tissue form the framework of the living machine. The origin of the energy manifested by this machine, we will consider later. Its active power is largely manifested in the form of motion or movement, in which the voluntary muscles or "organs of the will" play a large part. There are certain cells exhibiting amœboid movement, and ciliated cells which also produce partial movements of the human body, but the various kinds of muscles are of prime importance in its various acts.

We are familiar with muscles in the form of red meat from the butcher shop. Muscles constitute about one-half of the body in bulk. There are two main



EXTERNAL LAYER OF MUSCLES OF THE BODY

classes of mucles, the voluntary which are under the control of the will, and the involuntary which do their work independently of the will. In general the voluntary muscles are attached to bones and for this reason are sometimes called skeletal muscles. They are about 500 in number. The involuntary muscles are found in the organs of the body, as in the walls of the stomach, intestines, and blood vessels. Their particular function is to assist in the work of the various organs by moving their contents, as illustrated by the movements of the stomach and intestines during the process of digestion.

Fibres and Tendons

If a single muscle is examined carefully, it is found to be made up of a number of bundles of red fibres bound together by means of white connective tissue. At each end of most of the voluntary muscles is a strong white cord—a tendon, which serves to connect the muscle to the bone. Every muscle is supplied with nerves and blood vessels which ramify throughout the bundles of fibres.

The special property of the living muscle is that of contractility,—the power of shortening in length while it increases correspondingly in width. The two ends of a muscle being attached to separate bones, the shortening produces motion. This action leads to those motions which make locomotion and other activities possible.

The muscles are found passing over all the joints, one or more on each side, thus making it possible to

move the joint forward and backward. In some places, as in the shoulder joint, the arrangement is such that the arm can be moved in all directions. The muscles which bend a joint are usually three or four times as strong as those which straighten it. This fact is easily demonstrated by comparing the strength of the muscles used in closing the hand with those used in opening it. Muscles which are used for heavy work tend to increase in size and strength, and also to shorten. Unused muscles become small and weak and tend to lengthen.

Muscles Hold the Bones in Position

The proper relation of one bone to the other in a joint depends on a definite relation between the length and the strength of the muscles which bend and those which straighten the joint. If the muscles which bend the joint are overdeveloped they shorten and stretch the extensor muscles. This gives a bent or crooked position of the joint, as illustrated in the half closed hand of the manual laborer, resulting from the constant grasping of tools, or the stooping attitude of the farmer from bending over in hoeing and other farm work. The same crooked position may result from great weakness of the extensor muscles even when the flexors are not overdeveloped. Furthermore, joints tend to maintain the position in which they are held most frequently. The drooping head, round back and protruding abdomen of the weak and undeveloped are all too familiar.

This condition is the result of general muscular

weakness, and lengthening of the extensor muscles, particularly of the muscles on the back of the neck and chest, the abdominal walls, the hips, and the knees.

The proper relation between the flexor and the extensor muscles of the various joints is essential to beauty of form and grace of movement in the human body. When this relation exists the muscles being of exactly the proper length and strength they are balanced.

THE NERVOUS SYSTEM

The nervous system is the governing mechanism of the body. It controls and regulates every activity of the body, brings the individual into conscious relationship with external nature by means of sensation, motion, language and all the mental manifestations.

The cerebro-spinal nervous system consists of the brain, the spinal cord and the nerves.

Every organ and part of the body is connected with the brain by means of the nerves. Every movement we make is the result of muscular contractions which have been ordered or stimulated by the brain.

A Nerve Cell

A nerve consists of the nerve center, located in the brain, spinal column, or ganglia, from which extends the nerve fiber. The nerve centers are the sending and receiving stations—the fibers, the wires. We do not know just what a nervous impulse is, but it seems to be electrical in nature, although the nervous im-

pulse travels much more slowly than the electric current.

The Brain

In a general way the brain consists of nerve centers which have for their function the regulating of the various activities of the body. There is, for instance, a center regulating eyesight, another has to do with hearing. In the same way there are centers for speech, smell, breathing, coughing, the beating of the heart, the secreting of the various glands, the movement of each group of muscles, and all the other activities of the body.

Special Centers

The nerve centers in the brain are numerous and their functions very complex. For example, when a muscle is exercised vigorously, it requires an increased supply of blood and its sensory nerves carry a stimulus to a particular center in the brain. This center sends stimuli to the centers which regulate the breathing and the beating of the heart, and these centers, in turn, send stimuli through motor nerves to the heart and muscles of respiration to increase their activity. All the muscles and other organs are connected in a similar way with the various centers in the brain by means of the nerves.

Kinds of Nerves

A nerve fiber carries impulses only in one direction, to a center or from a center. In general the nerves which carry stimuli from the parts of the body to the brain are called *sensory nerves,* and the nerves which carry stimuli from the brain are called *motor nerves,* because nearly all the stimuli coming from the brain produce movement or activity.

Nature of Nervous Impulses

All nervous impulses are thought to be alike. They vary only in intensity and in the method of stimulation, thus the nerves in the retina of the eye are sensitive only to light; those in the inner ear, to sound. If it were possible to change the nerve fibers about, so that those coming from the eye were connected with the centers which interpret hearing and vice versa, we would, as has been said, "hear the lightning and see the thunder." It is a common experience that a person who has lost a foot or arm still interprets stimuli of the nerves which formerly came from the lost member as if the foot or hand were still present.

Voluntary Nervous System

Most activities are under the control of the will. When we get up from a chair or carry a glass of water to the mouth, we call it a conscious act because the stimuli to the various muscles involved originate in the will. But if every act depended on the will for its instigation and direction we would remain helpless as an infant. The development and training of the nervous system results in many acts becoming automatic. The child learning to walk takes months of repeated conscious effort to learn to stand, and several more months to learn the movements of walking. Gradually the act of balancing, and the movements involved in placing one foot in front of the other, are performed unconsciously or automatically, and the child is able to walk, and later to run, without any conscious effort. In the same way we learn to speak, to eat, to put on our clothes, to write, and to make a

great many complicated movements which at first require conscious effort, but gradually are performed automatically.

Automatic Acts

The back of the brain and the spinal cord have for their particular functions the regulating of these automatic acts, and this results in a tremendous saving of time and energy. If it were not for this provision, we should spend most of our time and energy in dressing, for the fastening of every button and hook would require many conscious efforts on our part. Every new movement has to be repeated a great number of times as a conscious effort before it can be directed by an automatic center.

Reflex Acts

There is still another class of nervous reactions not under the control of the will, called reflex acts. A wink is a typical reflex act. A sudden strong light causes the eyes to close before we have time to think about it, or even to prevent it. Reflex acts are largely associated with the protection of the body from harmful conditions. Too strong light or dust irritating the eye causes the lids to close; heat coming in contact with the hand causes the arm to be snatched away; a pin pricking the sole of the foot causes the leg to be drawn up quickly. All these movements take place with great rapidity and without conscious effort. The irritant stimulates the sensory nerves in the part; the stimulus is carried to a sensory center; from there, another stimulus is sent to the proper motor centers, and these in turn send stimuli to the muscles

which by their contraction protect the part from injury.

Sympathetic or Ganglia Nervous System

Besides the central nervous system, there are numerous little bodies or nervous tissue called *ganglia* which are for the most part independent of the brain and spinal cord, although connected with them. There are two chains of these ganglia in front of the spine and others in the heart and other organs, all of which send out numerous nerve fibers. They are connected with the activities of the organs not under the control of the will like the heart, the blood vessels, the stomach and other digestive organs, and in fact all involuntary activity. This is what is called the sympathetic nervous system.

In many places in the body, numerous nerve fibers interlace, forming *plexuses,* especially around the blood vessels. The great plexus of nerve fibres in the abdomen is called the "solar plexus."

Stimulation and Inhibition

Many of the organs controlled by the involuntary system have two sets of nerves opposite in their action; for example, one set of nerves accelerates the heart beats, another retards, or "inhibits," action; in the stomach, one set brings about the secretion of the gastric juice, another is inhibitory.

In health all this marvelous complexity of nervous organization is in perfect co-ordination. The nervous system is wonderfully protected in all parts of the body, for it controls the growth and function of all the cells.

THE SKIN AND CONNECTIVE TISSUES

There are various complicated classifications of the tissues. It is enough for our purposes to divide them arbitrarily into skin or protective covering, and connective tissue, the latter term covering many subdivisions.

The Skin

The skin consists of layers of tissue of varying thickness which cover the whole body. If we examine a piece of skin in cross-section, we find on the surface a thin layer of hard, flat cells without nerves or blood vessels. This outer surface is called the epidermis, is composed of minute particles of horny matter and is constantly being shed. The sensation of touch and the effect of temperature on the surface of the body are greatly diminished in intensity because of this covering, as it contains no nerves or blood vessels. The great sensibility of the under skin when the outer covering is removed, is illustrated by the practice of a famous burglar who was able to open bank safes by pressing the ends of his fingers, from which he had removed the outer skin, against the lock on the safe and thus feeling the clicks as the knob was turned.

Dermis

The under skin or dermis is filled with a meshwork of nerves, blood vessels and glands. While it is dense and fibrous, if wounded gives rise to pain and easily bleeds.

Mucous Membrane

At the margins of the various apertures of the body is a layer of skin, redder, more sensitive, and continu-

ally moistened by a fluid which it exudes. This is *mucous membrane* and lines all interior cavities. This is a skin and consists of two layers now called the dermis and the epithelium.

The ducts of the glands in the dermis pierce the outer skin, but the nerves and blood vessels are all below the epidermis.

Glands of the Skin

There are two kinds of glands in the outer skin, the sweat glands which secrete water and waste matter dissolved in perspiration, and the oil glands which secrete an oily material useful in keeping the skin soft and pliable.

Sweat Glands

The sweat glands are very numerous. They are eliminating perspiration continuously, but most of it dries on the skin without giving a sensation of moisture. It is only when these glands are stimulated to great activity by vigorous muscular exercise, nervousness, emotion or heat, that the sweat accumulates in drops which perceptibly moisten the skin. These glands in an adult secrete on an average about one quart of perspiration in 24 hours, and a much larger quantity in hot weather.

Temperature Regulation

The sweat glands serve to regulate the temperature of the body. Under active muscular exercise in the heat of summer, or in overheated rooms, large quantities of blood flow through the capillaries of the skin, the sweat glands are stimulated to greater activity, and the sweat poured out of these glands serves to cool the body by evaporation. Evaporation, as we know, requires a large amount of heat.

Experiment. Rub a drop of ether, alcohol, or gasoline on the back of the hand. The skin is chilled by the evaporation. A like quantity of water in evaporating will carry away much more heat, but as the volatilization is not so rapid the cooling is not so noticeable.

The process is reversed when the body temperature is too low and the surrounding air is very cold. Under these conditions the capillaries in the skin contract, very little blood flows through them, the sweat glands almost cease their activity and a very small amount of heat is lost from the body by evaporation. The normal activity of the skin therefore is an important factor in maintaining health and preserving energy.

Sebaceous Glands and Hairs

The oil glands are found all over the body except in the palms of the hands and the soles of the feet. Each gland is located at the root of a hair and opens into the depression in the skin or hair follicle which contains the hair. The hairs are so small and short in many places that they are practically invisible. When a cold draft strikes the skin suddenly, we have what is called "goose flesh," due to the contraction of a tiny muscle near the bottom of each hair follicle which causes the hair to straighten up or "to stand on end." The amount of oil secreted by these glands varies in different persons, and in different races. It is well known that negroes have much more oil in the skin than whites. A certain amount of oil is essential to the health of the skin and to keep it soft and pliable.

Complexion

In the deeper part of the dermis is found a coloring matter which determines the complexion. The amount varies greatly in different individuals and in different races. A dark skin is due to the presence of a large quantity of this pigment in the dermis. Negroes have a very great amount of coloring matter, whereas persons with fair complexions have very little. Freckles are caused by the accumulation of pigment in spots. The amount of pigment in the dermis cannot be altered by the application of medicinal preparations or the taking of medicine internally. The various facial preparations advertised to bleach and beautify the skin consist of some form of scented pomade usually containing arsenic. Such preparations are harmful. The arsenic does not decrease the amount of pigment in the skin, it simply interferes with the circulation of blood in the capillaries and produces a certain pallor characteristic of arsenical poisoning.

Fat in the Skin

In the deeper layer or dermis, and just beneath it, is found a layer of fat. The amount varies greatly in different persons at different ages, and in the sexes. This fat protects the body from cold, rounds out the form and serves as reserve fuel supply for the body. The angular form of thin persons and the wrinkles of old age are largely due to a diminution of fat under the skin.

The skin varies in thickness in different parts of the body. On the eyelids and most of the covered parts of the body the skin is quite thin, but on the palms of the

hands, the soles of the feet, and the scalp, it is often very thick. This is especially true of people who do manual labor and walk or stand all day. Under these conditions the skin thickens to protect the delicate parts beneath from the constant pressure on the surface. This thickening becomes excessive and causes great pain when the pressure or friction is too long continued, as when a callous is formed on the hand by doing manual work, or a corn on the foot by wearing too small or ill-fitting shoes.

The nails and hairs, like the callous, are only modifications of the skin, serving for protection of exposed and delicate parts of the body.

Cartilage

In early years many parts of the supporting framework which later became bone consist of cartilage. The infant softness comes from the cartilaginous condition of many bones, these being known as the temporary cartilages, as later ossification will take place and the cartilaginous be replaced by true bony tissue.

In certain portions of the body, however, the cartilaginous or permanent tissue remains such through life unless calcified or hardened and made unyielding by deposits, as often happens in old age.

In its pure form, cartilage is flexible and elastic, and contains few blood vessels and living cells.

Connective Tissue

The connective tissue constitutes the final group of the supporting tissues and has many diversions, from a white fibrous variety mainly connected with muscles and joints to the jelly-like connective tissue making up the vitreous humor of the eye.

THE SENSE ORGANS

Something of the structure of the organs which support the frame-work of the living machine, the bones and connective tissue, has been described. Those which move it, the muscles and cerebro-spinal nervous system, have been briefly considered. There remains to touch upon, the sensory organs, before considering those which are more intimately connected with the "running of the machine."

Sensation

There are only certain organs which convey the various impressions from without. Any surface of the body may be sensitive to, or "feel" the sensation of heat or of cold, but only certain portions of the body are capable of reporting sound, light, or smell. Therefore, those organs which put us in some particular relation with the outer world are termed sensory organs.

Sense Organs Develop the Brain

Since between these sense organs and the sensory centers, the brain, the nervous impulses are the only means of communication, it is of prime importance that the nervous system be a perfectly working part of the human machine. It is of course important that the special sense organs of sight, sound, smell and taste be highly developed, educated and healthy, but it is through the sense of touch and motor activities as well as what we call thought that the higher nervous organization of man has been evolved. It is

through the sense and motor activities that man has been able to modify his primitive instinct. It is through the education of the senses that man is raised above the animal. In many animals the special senses of sight, hearing, taste and smell are more highly developed than in man, but in no animal does the ability to make complicated movements approach that of man.

Sense End Organ

The fundamental part of every sense organ is what may be termed the *end* organs. These are masses of highly sensitive tissue so placed as to be normally acted upon by one of the modes of motion met with in the external world. This end organ must have a sensory nerve fibre connecting with a nerve center in the brain. Seeing and hearing are the two most specialized senses and will be considered separately. The others are the sense of touch, the senses of heat and cold, the senses of smell and taste, the sense of pain, the muscular sense, and what may be termed common sensation, as hunger, thirst, fatigue, restlessness, and the like.

Tactile Senses

The sense of touch which is really the pressure sense is located in the skin and mucous membrane. It varies in acuteness in different portions of the body, being most marked at the tip of the tongue, fingers, and lips. The tactile impression is a very necessary one in education and should be developed far more than is usually the case, and those who, like Helen Keller, are both deaf and blind receive all their education through the tactile sensations.

Temperature Sense

According to the older view, the temperature sense as well as the sense of pain was thought to be a part of the sense of touch. It is now known, however, that in the skin there are distinct and separate nerve endings for heat, for cold, and for pain, as well as for pressure. The distribution of the hot and cold spots on the skin can be localized by passing a hot and a cold wire successively slowly over any part of the skin, as on the back of the hand.

Sense of Pain

The nerve endings for the sense of pain are most numerous in the skin. The internal sensations of pain are usually referred indefinitely to some part of the surface of the body—for the heart to the region of the shoulder blades, for the intestines to the back, from the stomach to the end of the sternum.

Muscular Sense

We are not usually distinctly conscious of muscular sensibility. Our ideas of weight and resistance, although depending in part on the sense of pressure, are largely determined by the muscular sense. Judgment of distance depends on visual impression combined with the contraction of the ciliary muscles in focusing, especially for near objects. The muscular sense is thought to have much to do with the proper contraction of the muscles and thus becomes important in all voluntary movements. It is probable that through the muscular sense is received the impression of fatigue.

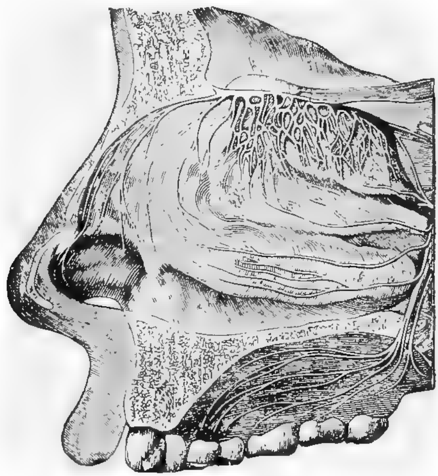
Sense of Smell

The sense of smell is located in the mucous membrane lining the upper part of the nasal cavity in which the olfactory nerves are distributed. Its important

function is to guard us against the breathing of impure air.

Sense of Taste

The sense of taste may be a highly specialized sense and is so needful a part of the acts of nutrition that it



SECTION OF THE NASAL CAVITY, OLFACTORY NERVE INDICATED

should be considered a most important sense. It is localized mainly in the mucous membrane covering the upper surface of the tongue.

Primary Taste Sensations

The sensation of taste may be resolved into four primary tastes—sour, sweet, bitter, and salty. All our sensations of taste are the result of the mingling of these primary tastes with the sense of smell. Many of

the so-called tastes are in reality given through stimulus of the olfactory nerves. This is largely so in the case of fragrant fruits, the bouquet of wines, and in fact all substances of which we say that the taste and smell is alike. The expired air, passing over the food, carries some of the delicate ethers across the olfactory nerves, thus we have a combination sensation of taste and smell. This fact is recognized when one has a bad cold; many things "do not taste." Holding the nose is a common practice when disagreeable medicines must be taken.

As we shall see later when considering gastric digestion, taste and smell have a marked effect on the flow of the gastric juices so that we need to cultivate these senses, and pay more attention to their proper function than is often the case.

THE SENSE OF SIGHT

Structure of the Eye

The eyes are in some ways the most important organs in the body. The eye consists of the eye-ball and the optic nerve. From the front of the eye-ball to the retina at the back, the light passes through a small, transparent body called the lens which answers the same purpose as the lens in a camera in making an image. The retina corresponds to the photographic plate and the lens focuses the image upon it. Normal vision depends on the proper distance between the lens and the retina. In focusing a camera, the lens is moved back and forth until a point is found where the

distance between the plate and the lens is just right to give a clear reflection. Clear vision depends upon the same principle, except that the lens in the eye is not moved backward and forward from the retina, but the shape or curvature of the lens is changed, thus giving the same result.

Accommodation

The change in the shape of the lens is accomplished by a little muscle called the ciliary muscle which, by pulling on the suspensory ligament, changes the shape of the lens according as we wish to look at an object near or far away. This mechanism for focusing the eye on objects at various distances is called accommodation.

The Iris

Another structure on the eye-ball, called the iris, is important. It is a little curtain-like arrangement placed in front of the lens and serves to regulate the amount of light entering the eye. The change in the size of the opening, or pupil, may be seen by placing the hand on the eye for a few minutes and then removing it quickly, when the pupil will appear very large but will soon become much smaller as it is exposed to the light. The pupil is largest when we open our eyes in the dark, and smallest when we look at a bright light.

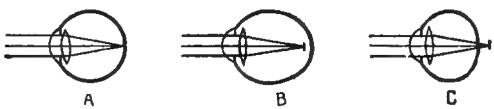
Defects of Vision

In many persons the shape of the eye-ball is such that perfect vision is impossibie. The eye-ball is sometimes too long. When this occurs, the clear image falls in front of the retina, and in order to see clearly it is necessary for the ciliary muscle to be in a state of constant contraction. This causes eye strain with its

many disagreeable symptoms. This condition is called near-sightedness or myopia, and is corrected by wearing a concave lens in front of the eye.

The opposite condition, or far-sightedness, is caused by the eye-ball being too short and the clear image falling behind the retina. This may be corrected by a convex lens in front of the eye.

In old age the elasticity of the lens become impaired and it cannot be sufficiently contracted to bring



CURVATURE OF THE EYE-BALL
A, Normal. *B*, In Near-Sightedness. *C*, In Far-Sightedness.

near objects into focus, so that convex glasses are required.

Astigmatism

Another very common defect of sight is astigmatism. This is due to irregularity in the curvature of the cornea, which prevents a clear image in all parts of the retina. To correct this a cylindrically ground lens is necessary.

In many persons the two eyes are not alike. One eye may be defective while the other is normal, or the two eyes may have similar or opposite defects.

Eye Strain

Eye strain results from over-exertion of the ciliary muscle. Some of the most common symptoms are pain in the eyes, a headache located on the forehead or in the back of the head, and inflamed eye-lids. Dis-

turbance of the appetite, indigestion, and even nervous prostration may result from long continued eye strain. When any of these symptoms are felt the eyes should be examined carefully by an oculist and suitable glasses worn.

The eyes are moved upward and downward, from side to side, or rotated, by means of small muscles which hold the eye-balls in the sockets. Both eyes should move exactly together and in the same direction. When some of the muscles in one eye are too weak to do their work properly, squinting results. By operating on the muscles the proper balance between the muscles of one eye-ball and those of the other may sometimes be re-established.

Color Blindness

Color blindness is inability to distinguish all the colors. In most cases it is limited to inability to recognize red and green, but occasionally the defect extends to yellow and blue. Those who are unable to distinguish these colors see them all gray. There is no cure for this condition, but a certain amount of improvement is possible by education.

Care of the Eyes

To preserve the eyesight it is necessary to avoid excessive use of the eyes in work requiring close application, reading and sewing in a poor light, reading matter printed in small type and on glazed paper, and reading in the cars. When reading at night the pages should be held in such a position that there is no reflected glare from the paper.

If the eyes begin to smart or burn when reading or

sewing they should be rested by looking away, and if this symptom reappears after reading or sewing for a short time only, the eyes should be examined by an oculist.

Lighting

The light as far as possible should fall on the page or work from above and behind; thus when writing, the light should fall from the left side to avoid a shadow cast by the hand. There should be a shade over the source of artificial light and the room should have general illumination as well as the reading light.

Reading in street cars and railroad trains is injurious because the light is frequently poor and the jolting necessitates rapid accommodation of the eyes which very soon tires out the ciliary muscles and produces eye strain. As there is a definite relation between good eyesight and general health, no efforts should be spared to maintain a normal condition of the eyes.

Foreign Bodies in the Eye

Nature has provided considerable natural protection for the eyes. They are located in deep, bony sockets and receive additional protection from the nose, the eyelids, and the eyelashes. Injury to the eyes often results from foreign bodies entering the eye or blows received on the eye-ball. A cinder or other foreign substance on the eye-ball may cause much pain and considerable inflammation. If the foreign body is a piece of steel or anything sharp and hard which has fallen against the eye-ball with great force, it may penetrate and produce permanent injury. Very serious results from foreign bodies and wounds on the

eye-ball are caused by injury to the cornea, leaving scar tissue after the wound is healed.

A cinder or a speck of dust in the eye may be removed with the corner of a clean handkerchief by drawing back the upper lid gently. If the speck is imbedded in the eye-ball, the services of a physician should be secured at once.

Cataract Cataract is not a growth on the eye, as is often believed, but an opacity or loss of transparency of the lens. It is an affection of old people, with no apparent cause except old age. This trouble can be cured permanently by removing the optic lens—an operation which is not very serious.

Tears The lachrymal gland is a small gland located in the outer corner of the eye and secreting a clear fluid for the purpose of lubricating the eye-ball. This fluid flows down the tear passage at the inner corner of the eye to the nose. The lachrymal gland secretes normally an amount of fluid just sufficient to keep the eyes lubricated. Emotional excitement, irritating gases, inflammation of the eyes, and eye-strain stimulate this gland to greatly increased activity.

The size and shape of the opening between the eyelids has much to do with the expression and with the beauty of the face. The size of the eye-balls does not vary greatly in different persons, but the appearance of large eyes which is considered an element of beauty is due to the long opening between the lids.

The eyelashes are subject to a disease called "blear-

eye" or red lids, in which the roots of the lashes are inflamed, the edges of the lids become swollen, most of the lashes fall, and when new ones grow they are short and frequently grow inward, causing much irritation and pain. This disease does not respond easily to treatment and in every case an oculist should be consulted.

Eyebrows

The eyebrows consist of muscles, thick skin, and hairs. Abundance of hair, mobility, and the shape of the eyebrows are important features in determining the expression of the face. The growth of the hair on the brows is subject to the same limitations as the hair on the scalp and should receive the same care.

THE SENSE OF HEARING

The Ear

The ear is a very important organ but it usually receives much less attention and care than the eye. That part of the ear which is seen is the least important. If we look in the canal of the ear we see a curved passage ending in a very thin pink membrane, which closes the inner end of the canal. But if we could look through this membrane, commonly called the ear drum, we should see a small cavity, the middle ear, containing three little bones connected with each other, resting at one end against a small body shaped like a shell.

All these parts, the external ear, the external canal, the ear drum, and the three little bones, serve the pur-

pose of receiving sound waves and conveying them to the delicate auditory nerve which ends in many little nerve fibres in the well-shaped body in the inner ear.

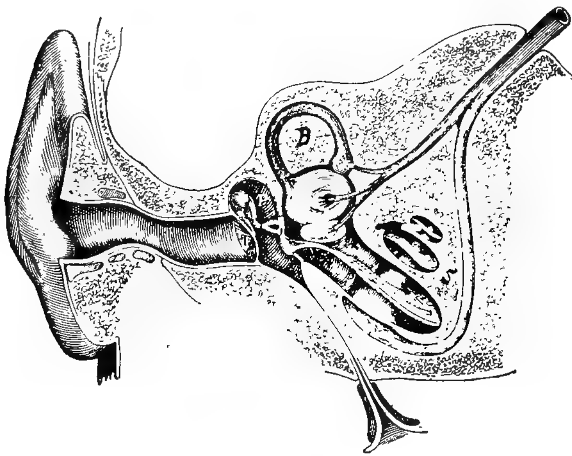


DIAGRAM OF THE EAR

The "auditory canal" is about an inch long, ending in the drum membrane *T*. The "middle ear" *p* contains the three small bones which transmit the vibrations of the membrane; *B*, Semi circular canal; *S*, Cochlea; *E*, Eustachian Tube.

The auditory nerves receive impressions of sound from the vibration of little bones and transmit the impressions to the brain.

Semicircular Canals

In the little body of the inner ear is a small cavity containing a liquid. The function of this little cavity is to help to maintain our equilibrium; it is really a

kind of spirit-level which helps us to determine our relation to the horizon. There is a nervous connection between this little spirit-level and the stomach. When we lose our bearings, as for instance when we are on a ship, rocking and pitching, it is believed that the symptoms of nausea known as seasickness are caused by a disturbance of this little spirit-level in the ear.

Eustachian Tube

The cavity of the middle ear is connected with the back part of the nasal cavity by a small passage about the size of a goose quill, called the Eustachian tube. The walls of the middle ear, the Eustachian tubes, and the nose are all lined with mucous membrane. A very common trouble in our climate is a catarrhal inflammation of the mucous membrane. As the nose is the most common seat of this affliction, the connection between the nose and ears is exceedingly important, because cartarrh spreads easily from one organ to the other. Often deafness results from catarrh of the middle ear and every precaution should be taken to prevent inflammation of the post-nasal space.

The disease not infrequently spreads from the nose to the ears as a result of the common habit of sniffing salt water to relieve a cold in the head or as a treatment for chronic catarrh. The act of sniffing has a tendency to draw secretions from the nose into the ears. The use of a nasal douche or oil atomizer is far better for the nose and there is no danger of injuring the ears.

Acute inflammation of the ears which not infrequenty results in an abscess is a condition fraught with much danger. If the abscess involves the "mastoid cells" in the round hard bone behind the ear, there is always a possibility that it may break into the brain cavity and result in death.

Earache When a child complains of earache, a hot water bag should be placed over the painful ear and a doctor sent for at once.

Foreign Bodies in the Ear It happens quite often that children will put beans or other foreign bodies in their ears and be unable to remove them. In such a case no attempt should be made to remove the foreign body by prying it out with a toothpick or button-hook. The best thing to do is to send for a physician at once. If it is positively known that the foreign body is not a vegetable, the following procedure may be tried: Make a solution of soap and warm water, put it in a fountain syringe, hang the syringe a foot above the child's ear and allow the water to flow in the ear. This treatment would be very dangerous if the foreign body were a bean or pea because the water would cause the vegetable to swell and give intense pain.

Ear Wax Another most disagreeable condition of the ears is when a mass of hard wax accumulates near the drum; this causes much pain and the sufferer hears all sorts of loud noises. The treatment for this condition is exactly the same as for the removal of a foreign body. It is sometimes necessary to continue the use of the

syringe for twenty or thirty minutes before the wax is sufficiently softened to be washed out by the water. This condition is very common and may not give pain but simply make one a little hard of hearing.

The ear canal should be kept clean by rolling the corner of a soft moist towel and wiping the wax and dust which accumulates in the ear. Hair-pins, button-hooks, and toothpicks should never be used to remove wax from the ear, for there is danger of injuring the delicate ear-drum.

Deafness results from various causes. Catarrh, measles, and scarlet fever are often followed by deafness of one or both ears. The ears of patients suffering from any of these diseases should be watched carefully. **Deafness**

Having very briefly considered the human machine and the means by which its relations to the external is established, we will next take up the "running of the machine."

TEST QUESTIONS

The following questions constitute the "written recitation" which the regular members of the A. S. H. E. answer in writing and send in for the correction and comment of the instructor. They are intended to emphasize and fix in the memory the most important points in the lesson.

PERSONAL HYGIENE

PART I

Read Carefully. This is so essentially a personal subject that many of the questions are made personal. To obtain the greatest benefit from these lessons such questions should be answered fully. It will be desirable if possible to supplement the text by reading some of the books mentioned in the program for supplemental study. Your questions should enable the instructor to supplement the text. Write on one side of the paper only and leave space between answers.

1. To what extent have you studied the subject of personal health before reading these lessons?
2. On what factors does personal health depend? In your own case, which is the most important?
3. What can you say from your personal standpoint of the value of health?
4. What are the fundamental living units of the body? How are they combined and how is their life governed?
5. Describe the structure of a bone; a muscle; a nerve.
6. What are the functions of the nervous system? Answer fully.
7. Through what means is the brain developed?
8. How should the eyes be cared for? What attention do you give to your own eyesight?
9. Describe the ear. How may deafness be brought about?
10. What is the aim of personal hygiene?
11. What questions have you to ask?

Note.—After completing the answers, sign your full name.

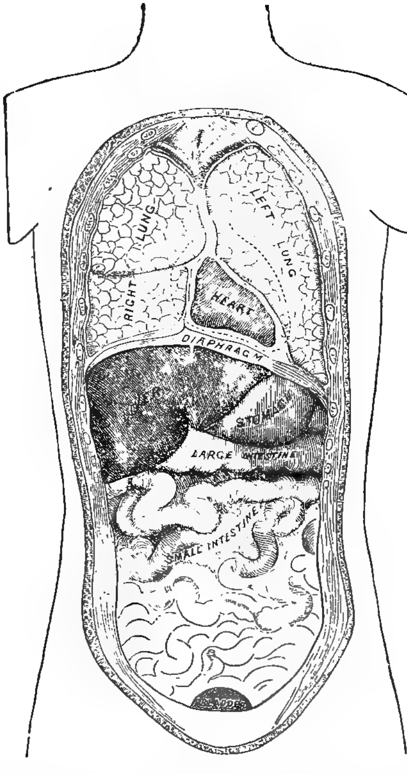


DIAGRAM SHOWING POSITION OF LARGER ORGANS IN THE BODY.

PERSONAL HYGIENE

PART II

Running the Machine

THE living body cannot create energy. It can only, in common with other machines, use the energy provided, and transform it into other forms of energy—heat energy, mechanical energy, and, perhaps, electrical energy. Food is, as we know, the fuel of the human machine, but it is only by combining with *oxygen* that the nutriments of food can yield their store of energy to the body.

Source of Energy

The primary source of all terrestrial energy is the light and heat coming from the sun, except the small amount from the internal heat of the earth and that from the tides. This energy is stored up by plant life—by the greenery of nature. It is only by means of the *chlorophyl* of green leaves that the energy in light and heat can be used to *build up* the complex compounds which are *broken down* by animals and plants in the construction of their cells, and in maintaining life. Every life process, vegetable and animal, except the action of the chlorophyl, uses this stored energy and dissipates a part chiefly in the form of heat. Thus, the human machine uses the energy from the sun, stored up in food, for maintaining its bodily temperature, for muscular work, for the digestion of food, for thinking, even.

Transformation of Energy

All forms of energy are easily transformed into heat. For example, energy from the sun may be stored up by the corn plant in seed, part of the grain may be transferred into the flesh of an ox, and the meat consumed by man as food. Through the energy of this food a man may carry a stone up a mountain. In rolling down the mountain side, the energy of position of the stone is changed into heat through friction. Thus the energy stored up from the light and heat rays of the sun, through a devious path, is changed again into heat. The scientists suppose that the ultimate end of all forms of energy will be "uniformily diffused heat." The part that each one of us has to play in this mighty cycle is to make the best possible use of the energy given him to transform.

Use of the Energy

Of the energy supplied to the body in food, only about 20 per cent can be used for external work, as in walking, the lifting of weights, or riding a bicycle. The remainder leaves the body as heat. Some of the energy leaving the body as heat is first used in internal work, *i.e.*, in circulating the blood, in the digestion of food, etc. By far the largest part of the energy is expended in maintaining the temperature of the body.

Heat Losses of the Body

The U. S. Department of Agriculture has determined, in the respiration calorimeter, the outgo of energy from the human body under various conditions. (See *Food and Dietetics*, pages 32-52.) The

results for an average sized man per hour are given as follows:

HOURLY OUTGO

Average (154 lbs.)	Carbon Dioxide (gms.)	Calories	Foot Tons
Man at rest (asleep)	25	65	100
Sitting up (awake)	35	100	154
Light exercise	55	170	262
Moderate exercise......	100	290	447
Severe exercise........	150	450	694
Very severe exercise....	210	600	926

Note. — A calory is the qantity of heat required to increase the temperature of 1 kilogram of water 1° Centigrade (or about a pound of water 4° F.) .This is equivalent in mechanical energy to about 1.54 foot-tons. A foot-ton is the energy required to lift one ton a foot high against gravity.

With body weight greater or less than 154 pounds. the energy outgo would proportionally be greater or less, disregarding unusual fat.

Mechanical Efficiency of the Body

The efficiency of the body in performing external work varies greatly in different individuals and at different times. Some persons may be capable of doing twice as much work as others on the same amount of food. A tall, thin person loses more heat (and so energy), proportionally, than one with a more compact body, because of the greater skin surface compared to weight. When all the organs are in perfect condition, the efficiency of the body is high. Indeed, the mechanical efficiency of the well-trained body is higher than that of most machines — a locomotive for instance can use only about one-tenth of the energy supplied to it in coal.

But muscular efficiency is not the highest human efficiency; mental efficiency is of a higher order. This, too, depends upon the proper workings of all

parts of the machine—on right living. Although the human body is a machine—a self repairing automobile—it is dominated by the mind, and has imagination as well as reasoning powers. So in considering the body as a machine, we must not forget that mental conditions may make mechanical rules false.

Work of the Organs

The organs of the body which convert food into nutriment are the *alimentary*. Those which convey this nutritious material to all parts of the machine are the *circulatory*, and those which eliminate waste matters are the *excretory*. The *respiratory* organs play a double part, being both eliminators of waste and importers of the most necessary factor in all this process—OXYGEN.

Work of the Nervous System

All this intricate machiney, however, would be of little value without the engineer. The machine would stand idle and rust away without the co-ordinating action of the nervous system. The nervous system stands as does the engineer regulating the functions of the organs, demanding food for the machine, discriminating in kinds and amounts. It guides the muscles, directs the digestion of food, the circulation of the blood, the excretory and respiratory processes. All these processes are dependent upon the normal healthy condition of the nervous system, which is, therefore, of paramount importance. Yet, this is intimately related with the healthy condition and normal action of *every* organ of the living machine, and, as we know, the over lord of the nervous system is the brain, the mind.

DIGESTION OF FOOD

The function of digestion is to render food soluble and capable of being absorbed into the blood, and thus brought to all the cells of the body.

The ailmentary canal is lined throughout with mucous membrane, which is much modified in parts. It is supplied with two layers of muscles (the stomach three) and covered with the serous membrane, which serves as protection, and for lubrication.

Mastication

Mastication is the only voluntary part of digestion, and that doubtless would be better performed if it was not under the control of the will. As the time of solution is dependent on the fineness of the particles to be dissolved, mastication is an important part of digestion. It is only necessary to note the difference in time required to dissolve large and fine crystal in water to appreciate this fact. The time of complete solution is dependent on the size of the *largest* crystal or mass.

Saliva

During mastication food is moistened with saliva, which is secreted by three sets of salivary glands—the *parotid* in the cheek, the *sub-maxillary* at the side of the tongue, and the *sublingual* under the tongue.

The quantity and composition of the secretion varies with the character of the food being eaten. With dry food the flow is abundant, and the saliva contains the *ferment* ptyalin, which is capable of changing cooked starch into maltose and dextrine.

Enzymes or Ferments

These ferments or enzymes are very important in affecting chemical transformations of both animal and vegetable life. Their action is similar to that of so-called "catalytic" bodies—substances which by their presence bring about, or greatly hasten, chemical changes, but which, apparently, do not enter into the chemical actions themselves. A familiar example of catalysis is the changing of starch into glucose by boiling it for some time with a small amount of acid. There is just as much acid at the end of the action as at the beginning, and if it could be extracted and used over and over again, an infinite amount of starch might be transformed into glucose with a very small amount of acid. Now, if the acid had acted on an alkali, certain metals or oxides, it would combine with it and the acid would no longer exist *as acid*. It is thus apparent that the action in catalysis is quite different from the more common chemical action. Moreover, it is clear that calalysis is a most economical means of effecting chemical change.

A large quantity of an enzyme will make the action more rapid than a smaller amount, but the small amount would do the work if given sufficient *time*. The action of the enzymes is specific, that is, one kind of ferment affects only one kind of a chemical change.

Salivary Digestion

To return to salivary digestion. The saliva is slightly alkaline in reaction and ptyalin cannot work

in an acid medium. As the stomach secretions are acid, it was formerly thought that salivary digestion was of little importance, but it is now known that the food may remain in the large end of the stomach for an hour or more before it becomes acid, and so the digestion of the starch begun in the mouth may continue in the stomach.

Secretion of Saliva

The saliva also dissolves part of dry food, giving it taste, and as we shall see later, the sense of taste has a marked effect on the flow of the gastric juices.

The secretion of saliva is controlled by the nervous system, the higher nerve centers having considerable effect, for it is an every-day experience that the sight, the smell, or even the thought of savory food may "make the mouth water." On the other hand, strong emotion or fear may stop the secretions and the mouth becomes dry.

Ptyalin

When dry food is taken into the mouth, the saliva is rich in ptyalin, which comes most abundantly from the parotid glands. If the food contains much water, the secretion is meager and contains little of the starch converting ferment. This indicates that starchy food, such as bread, will have a better chance to be thoroughly digested if eaten dry. While the various actions in digestion support one another, still it is important that each stage be complete for perfect digestion.

Mastication and insalivation have long been recognized as impotant. The Gladstone rule of twenty-

five chews to each mouthful of food is familiar, and more recently, Fletcher and his followers have claimed that most of the ills which flesh is heir to may be corrected by long continued mastication. While "Fletcherizing" may not accomplish all that is claimed for it, yet the necessity for thorough mastication can hardly be over-estimated. Rapid eating usually means overeating, for it has been shown conclusively that when food is eaten slowly and masticated thoroughly, a less quantity is demanded by the appetite. It is safe to say that at least one-half of the digestive disturbances common to the American people result from the "bolting" of food.

The saliva also contains mucin, the constituent which gives it the ropy appearance. This helps to lubricate the food and make the act of swallowing easy. In swallowing, the food passes over the trachea, which is closed by the epiglottis. The opening to the nasal space is closed by the soft palate. The food reaches the stomach through the œsophagus.

The Stomach The stomach is a muscle covered, pear-shaped sac situated under the diaphragm, with the large end towards the heart. The œsophagus entrance, called the *cardia*, is closed by a circular muscle, and the outlet into the small intestines is guarded in a similar manner by the *pylorus*. When fully distended, the stomach holds from three to five pints, but when not occupied by food it is collapsed.

The herbivorous animals have two stomachs, one

chiefly for storage and the other in which more active digestion is carried on. In the same way, the human stomach is divided into a comparatively inactive and an active part. The pyloric end is the part chiefly concerned in movement and digestion, the larger end, called the fundus, serving to hold the food and make meals possible.

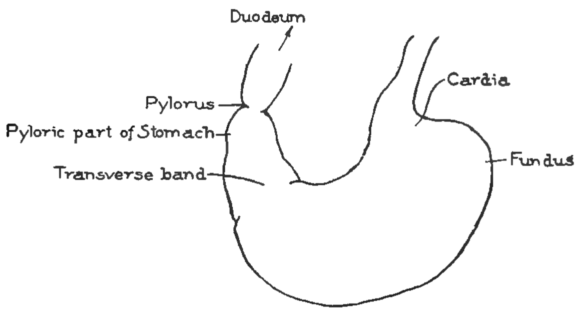


DIAGRAM OF THE STOMACH
(After Howell.)

The stomach is lined with numerous glands, which secrete the ferments, *pepsin*, *rennin*, and may be other ferments and hydrochloric acid. The pepsin glands are found in all parts of the lining, but the glands which secrete hydrochloric acid occur chiefly in the central portion of the stomach. The pepsin, in an acid medium, digests the proteids of food (the lean of meat and fish, albumen, casein of milk, gluten of wheat, legumin of beans and peas, etc.), changing

Gastric Juices

them into peptones or peptoses, which are soluble. The connecting tissues, which hold the globules of animal fats, are dissolved, and fats, which at bodily temperature are in a liquid state, are liberated. It was formerly thought that the fats were not digested at all in the stomach, but recent experiments show that finely divided fats—emulsions, like milk and the fats in the yolk of egg, are digested to some extent.

Beyond the coagulation of milk, the action of rennin is not known.

Movements of the Stomach

In the pyloric end of the stomach, wave-like contractions take place—in the human stomach once every 2 or 3 minutes. This mixes the food with the gastric juices, and helps to liquefy it. As the food reaches a semi-liquid condition of about the consistency of pea soup, the pylorus opens from time to time and small jets of the liquefied and partially digested food enter the small intestine. The large end of the stomach exerts a steady pressure on the food so that the active end is given a new supply. When the entire contents of the stomach becomes acid, the digestion of starch for the time being ceases. The whole process of stomach digestion occupies from three to six hours, after which time the pylorus opens and allows any insoluble substance remaining to pass into the intestines.

Control of Gastric Secretions

The cause of the flow of the gastric juices is an important consideration. Formerly it was thought

that the mere presence of food in the stomach was sufficient to bring about the necessary secretions, but by means of some wonderfully ingenious experiments on dogs, the Russian physiologist, Pawlow (Pav́-lov), has proved that this is not so. He introduced easily digested food, like egg albumen, into the stomach of a sleeping dog and found that it remained unacted on for hours, even after the dog was awakened. He stimulated the walls of the stomach mechanically in every possible way, and showed that no secretion followed. When, however, a hungry dog was even shown a piece of meat, after a waiting period of about five minutes, the gastric juices began to flow abundantly. The smell or the eating of foods by a hungry dog always produced active secretions, even though the food did not reach the stomach. The flow was in proportion to the *desire;* that is, greater when the dog was hungry and greater for well-liked foods. This secretion Pawlow called the "appetite juices," or the "psychic juices."

Appetite or Psychic Juices

Chemical Excitants

Only a very few substances were found to stimulate the secretion through their *chemical composition* —the most active being extracts of flesh, and to some extent water and milk, and gelatine slightly. The secretion brought about chemically was not nearly so great in amount or so long continued as that stimulated by the appetite through senses of taste and smell.

These psychic juices, once started, are in quite

large amount, increasing for an hour or so, and then diminishing. Pawlow found that after the psychic juices begin to digest the food, the *substances formed* caused an increased quantity of secretion, the composition depending upon the character of the food being digested — proteid food causing an increase in the quantity of pepsin, starch being without effect, and fats decreasing the amount somewhat.

Composition of Psychic Juices

Moreover, he found that on a given diet the *psychic* juices were always of about the *same* composition— a composition suitable for the food being eaten, that is, on a meat diet the secretion of pepsin was more abundant than on a bread and milk diet.

On changing, say, from a meat diet to a bread and milk diet, the change in the composition of the psychic juices was a gradual one. This indicates that a radical change of diet should only be made *gradually*.

These epoch-making discoveries emphasize the importance of appetite. Its importance has long been known from the experiences.

"Now, good digestion wait on appetite, and health on both!"—*Macbeth*.

Importance of Appetite

Pawlow's work, however, proved that former experiments which seemed to show that the flow of the gastric juices was excited mechanically were incorrect. This error led to the practice of paying chief attention to ease of digestion in selecting foods when there was digestive disturbance. While digesti-

bility must be considered in such cases, it is not enough to take the easily digested foods, for even they might not be properly digested unless *eaten with enjoyment.* Food, then, should be appetizing, it should be taken slowly and tasted to the utmost, it should be eaten under agreeable conditions and the mind should not be so occupied with other matters that the food is swallowed almost unconsciously.

Products of Stomach Digestion

The food leaves the stomach, a small part at a time, in a semi-fluid, partly-digested condition. The starch has been partly changed into maltose and dextrin, the proteids into peptones, the connecting tissues dissolved, the fats liquefied and finely divided. The process has been mainly a preparatory one.

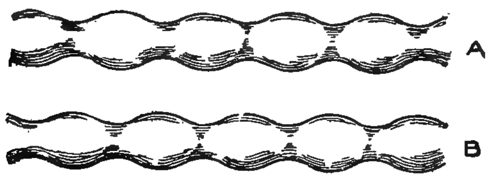
Although there is some absorption in the stomach, it is of minor importance. Alcohol, some salts and some drugs are rather quickly absorbed there and enter the circulation.

Digestion in the Small Intestine

The most important part of digestion takes place in the small intestine. This is a tube from 20 to 25 feet long and about one inch in diameter. It is lined throughout with glands, and has a muscular covering, which keeps the contents constantly in motion.

The movements of the small intestines are of two kinds—one which mixes the contents and the other which moves the contents forward. These movements may be illustrated as follows: Fill a rubber

tube with water and tie both ends. With the fore fingers of each hand curved around the tube, press slowly and alternately, first with one hand and then with the other. This gives a backward and forward movement. Multiply this arrangement a few hundred times and the condition in the intestine is exemplified. Now run one finger slowly along the



MOVEMENTS OF THE SMALL INTESTINES

A, First position. *B*, Second position. Alternate movements give the backward and forward movement of the contents.

whole length of the tube; this gives the forward movement called peristalsis.

Intestinal Ferments

The first portion of the small intestine leading from the stomach, is called the duodenum. Near its beginning enter the secretions of the pancreas—the most important digestive fluid of the body. This is strongly alkaline and yields at least three ferments. (1) *Trypsin*, which changes the proteids into peptones and these into simpler substances containing nitrogen, and others which do not contain nitrogen. It is much more active than the pepsin of the gastric juices, *except in dissolving connecting*

tissue. (2). *Lipase*, a fat splitting ferment which separates the fats into fatty acids and glycerine. (3) *Amylopsin*, much like the ptyalin of the saliva, which, like it, changes starch into maltose and dextrin, but much more actively. Rennin is secreted, also.

The Bile

Very near the entrance of the pancreas is a duct, which brings a fluid secreted by the liver—the bile. This is in part a waste product from the blood. It is stored in the gall bladder until needed for digestion. The bile increases the power of the fat splitting ferment of the pancreas, and helps to dissolve some of the soaps formed when the fatty acids combine with the sodium carbonate in the alkaline juices.

Intestinal Secretions

The glands in the walls of the small intestine itself give a secretion which contains a number of ferments, one of which Pawlow has called a "ferment of ferments." This greatly increases the activity of the proteid ferment in the pancreatic juice. Another of the ferments converts the maltose and dextrin formed from starch into dextrose. Two others change cane sugar into dextrose and levulose and milk sugar into dextrose and galactose. It is necessary for the carbohydrates to be converted into simple sugars to be useful in nutrition. Still another ferment acts on the peptones, changing them into simpler bodies.

The intestinal secretions also contain a very interesting substance which, when acted upon by the acids

of the gastric juice, forms a substance which enters the blood and stimulates the secretions of the pancreas, and possibly the bile. Thus, indirectly, the regularity of digestion and expulsion of the contents of the stomach controls the secretion of the very important pancreatic juices.

Absorption Active absorption takes place in the small intestine. The surface is very greatly increased by minute filaments called *villi*. Each contains blood vessels and a lacteal. The digestive products of proteids and carbohydrates are absorbed into these blood vessels and the fatty acids and soaps by the lacteals. The veins of the villi enter the portal vein, which passes to the *liver*, where the products of digestion undergo further changes before entering the general circulation. The liver converts a portion of the sugar into *glycogen*, storing it for future use and maintaining a constant percentage of sugar in the blood. The products of the fats—soaps and fatty acids, absorbed by the lacteals, are to a large extent immediately made into fats in the walls of the intestine. The lacteals unite into larger vessels, which finally combine into the thoracic duct, from whence the fats pass into the general circulation near the heart.

How and why absorption takes place in this manner is beyond present knowledge. Here, as elsewhere in the body, substances must pass through membranes. There are no holes. The living cells have the power of selective absorption and control

the process, although the physical laws of diffusion and osmosis must operate to some extent.

Large Intestine

The entrance into the large intestine is guarded by a circular valve. The large intestine, or colon, is about five feet long and two inches in diameter. It is divided into an ascending, transverse and descending portion, and joins the rectum by the *sigmoid flexture*. The movements of the large intestine are somewhat similar to those of the small intestine, but less frequent. No enzymes are secreted here, but those already mixed with the food continue active. A mucus-like substance is secreted, which serves for lubrication. The food entering the large intestine is of about the same consistency as when it left the stomach, absorbtion balancing secretion in the small intestine.

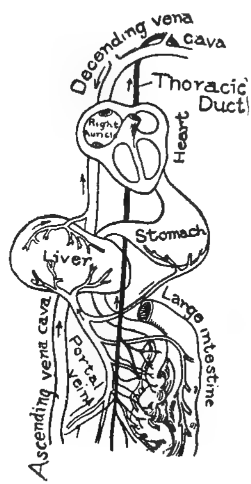


Diagram of the Circulation from the Digestive Organs.

Absorption in the Colon

Absorption takes place more actively than secretion in the large intestine, and the contents gradually become solid and are expelled into the rectum. The nutriments absorbed take the same course as from the small intestine, the fats to the lacteals, the sugars, etc., to the portal vein and liver.

Bacterial Action in Digestion

The action of bacteria in digestion remains to be considered. All foods contain bacteria — some in immense number. (See *Household Bacteriology.*) While solid food is being stored in the large end of the stomach, the bacteria act on the carbohydrates to some extent, but cannot affect the proteids ordinarily present in food. If stomach digestion is unduly delayed, carbon dioxide and other gases may be formed, which cause belching and flatulence. In normal conditions, the contents of the stomach soon become acid from the hydrochloric acid, which destroys nearly all kinds of bacteria and renders the few that remain inactive.

The contents of the small intestine are neutral, or slightly alkali, and fermentation of the sugars may take place, also putrid fermentation of the peptones, unless they are absorbed promptly. Conditions in the large intestine are favorable for the growth of bacteria and putrefaction of proteid materials goes on. Substances are formed which, if absorbed in small quantity, are disposed of in the liver and promptly secreted in the urine. If, however, there is much undigested or unabsorbed nitrogenous material, or if it remains for too long a time, toxines may be formed which, entering the blood, cause headache, and the condition conveniently termed "bilious."

Bacteria Unnecessary

The statement has been made that the action of bacteria is necessary for digestion, but this is prob-

ably incorrect, for some of the animals of the arctic regions have no bacteria in the intestines. It is possible that certain bacteria may act on cellulose, which the digestive juices of man are not able to affect, and render some of it digestible. Bacteria are always present in both the small and large intestines, but in the conditions of health they do no harm.

THE BLOOD

Composition of the Blood

The digestion of food keeps the blood supplied with materials used by the body for heat and energy, for repair, and for building. All the substances needed by the body for this work are contained in it. In addition, nearly all the waste products, gases and solids, form a part of the blood on their way to the organs of elimination. It is apparent that the composition of the blood must be very complex.

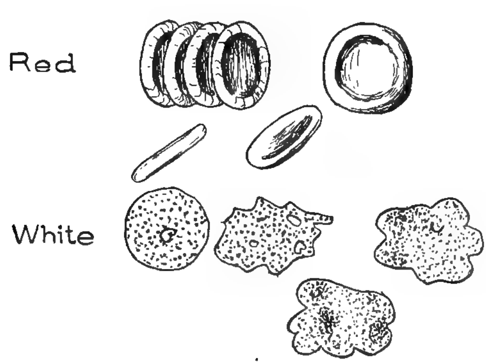
Plasma and Corpuscles

Under the microscope the blood is seen to consist of a nearly colorless fluid called the *plasma* and numerous corpuscles, the red and white. A drop of blood contains about 500 million red corpuscles and 500 thousand of the white corpuscles. The red corpuscles are concave discs and contain a substance—*hemoglobulin*—which gives the red color to the blood. With this substance oxygen forms a loose combination and the function of the red corpuscles is to carry the oxgyen absorbed in the lungs to each and every cell, to be used in combining with the nutrients of food and yield the energy necessary for cellular activity. The red corpuscles are formed in red bone marrow.

White Corpuscles

The white corpuscles are not all alike, but may be roughly classed as the *leucocytes* and the *lymphocytes*. The leucocytes are formed chiefly in the white marrow of the bones. They, like the amœba, have the power of independent movement, and can

even penetrate the walls of the capillaries and move between the cells. They repel or destroy bacteria or other foreign bodies, which may be introduced among the cells. The lymphocytes are formed in the lymph glands and perhaps in the spleen.



BLOOD CORPUSCLES

They are thought to aid in the absorption of fats and peptones, and help in the coagulation of the blood.

Blood Plates

The blood also contains very minute bodies called the blood plates. These are about one-tenth the size of the red corpuscles. It is thought that they aid in the coagulation of blood, beyond which their function is unknown.

The blood equals about $\frac{1}{13}$ the weight of the body — about twelve pints in volume. The plasma contains 90 per cent water, 7 or 8 per cent proteid

material, 0.1 to 0.2 per cent of sugar, a smaller quantity of fat, mineral salts, and a very great many other substances which, though small in proportion, are vitally necessary to the body.

Ductless Gland

Among the substances present in the blood in minute quantities are the secretions of the so-called *ductless glands*. The thyroid glands, situated in each side of the neck, contribute a secretion necessary for nutrition. Their complete removal leads to mental and physical deterioration and usually to death. The adrenal bodies, found near each kidney, secrete a substance necessary to maintain muscular tone, especially of the muscles in the walls of the small arteries. Death results from their removal. There are other small glands which also produce substances necessary for health. Numerous small bodies imbedded in the pancreas add to the blood an internal secretion absolutely necessary for the oxydation of sugar in the cells of the muscles and glands.

THE CIRCULATION

The blood is the connecting medium between all the organs of the body. The circulatory apparatus consists of the heart, arteries, capillaries, veins and lymphatics. The large arteries from the heart divide and subdivide until they become capillaries in the tissues. These are so numerous that a needle cannot be inserted anywhere in the flesh without piercing some. The capillaries unite into the veins which

carry the greater part of the plasma and all of the red corpuscles back to the heart.

Lymph

Part of the plasma passes through the thin walls of the capillaries and actually surrounds the cells. Here it is called *lymph*. *Each cell of the body is bathed in lymph.* The lymph, then, consists of blood minus the corpuscles and plus the products of cellular activity, which naturally varies with the kind of cells. The lymph between the cells drains back towards the heart through small vessels which originate blindly in the tissues. These *lymphatics* unite into larger vessels and finally empty into the right lymphatic and the thoracic duct, which pour their contents into the larger vein near the heart. Thus the blood leaves the heart through the arteries, passes through the capillaries and returns to the heart through the veins and lymphatics.

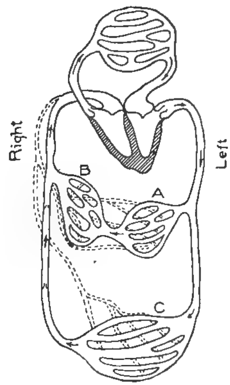


DIAGRAM OF THE CIRCULATION.

A. Capillaries of the digestive organs. *B.* Of the liver. *C.* Type of various systems of capillaries as in the leg, kidneys, brain, etc. *L.* The lungs. Dotted lines represent the lymphatics.

The Heart

The heart is a double muscular force pump, which keeps the life-giving stream of the blood in motion. Each contraction of the heart forces a jet of blood from one side through the arteries leading to all the

organs, and from the other side to the lungs. This throb or "pulse" can be most conveniently felt at at the thumb side of the wrist.

The course of the circulation is from the right side of the heart through the capillaries of the lungs, back to the heart, and from the heart through the arteries to the capillaries of all the other organs of the body, and back to the heart by various paths through the veins and lymphatics.

The walls of the arteries are strong and elastic. The pressure of the heart-beat dilates them and their contraction continues to force the blood forward between heart pulsations.

Rate of Flow

The flow of the blood is very rapid—about twenty feet a second in the arteries and large veins, but slow in the capillaries. The time required for a particle of blood to make the complete circuit of the body is about twenty-three seconds, on the average. It naturally takes longer for the blood to make the circuit through the foot than through organs near the heart.

The whole volume of the blood passes through the organs of the body, the kidneys for instance, a number of thousand times a day, thus bringing a constant supply of nutriment and rapidly carrying away wastes.

Nervous Control of Heart Beats

The heart is an automatic organ, and continues to beat when supplied with blood even when all nerve connection with other parts of the body is severed.

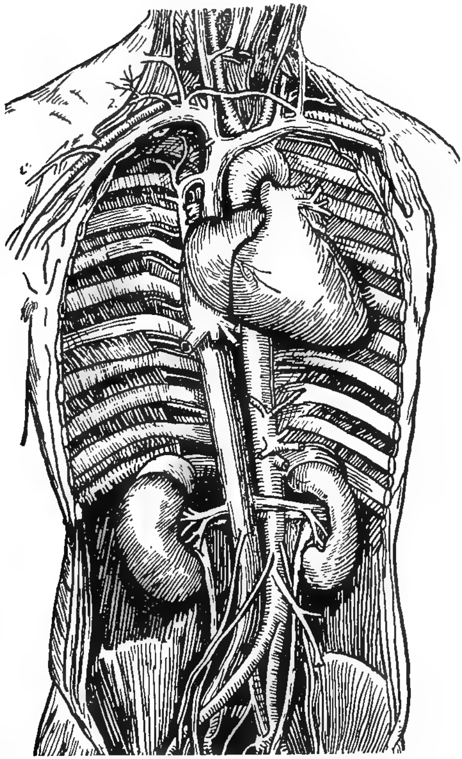


DIAGRAM OF THE HEART, LARGE ARTERIES AND VEINS SHOWING KIDNEYS.

Some of the salts in the blood keep up the action, probably by stimulating nerves in the heart itself. It also has two sets of nerves coming from the cord and from the back of the brain. One set of nerves called augmentor nerves or accelerator nerves, increases the rapidity and power of the heart-beats; the other set produces the opposite effect, decreasing the rapidity of the heart-beats. These are inhibitory nerves and their action is called "inhibition."

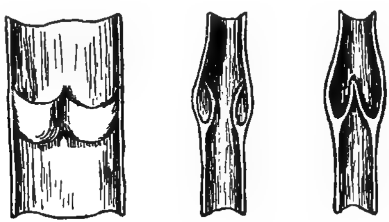
Distribution of the Blood Supply

The proportionate supply of blood which each organ of the body receives is regulated by the constriction and dilation of the small arteries. The muscular walls of the arteries are supplied with two sets of nerves—the vasco-constrictors and the vasco-dilators. When an organ is active, the arteries dilate, giving it a larger supply of blood. As the total quantity of blood is not sufficient to give all the organs the maximum quantity, the blood supply to other organs is diminished. This fact has many practical applications. When the digestive apparatus is active, some of the blood is drawn from other organs. If a heavy meal is taken, the blood supply to the brain may be lessened, and drowsiness result. In hot weather much blood flows to the skin, and mental work is more difficult. Active muscular exercise draws blood away from the internal organs, so violent exercise should not be taken directly after a heavy meal, for the stomach will not receive a sufficient blood supply for active secretion. If the sur-

face of the body is cold, the blood vessels supplying the skin contract, forcing an abundant flow of blood through the brain, under which condition it is difficult to go to sleep.

Accessory Means of Circulation

While the heart is the chief means of moving the blood, that in the veins and especially in the lymphatics is impelled towards the heart by two other



A B C

SECTIONS OF VEINS

a. Split open showing Pocket Valves. *b.* Valve open. *c* Valve closed.

means, the most important being respiration. At each inspiration, when the air is drawn into the lungs, there is at the same time a suction produced in the blood vessels and lymphatics of the chest. The alternate expansion and contraction of the chest and abdomen would simply make a backward and forward movement in the veins, if their walls were perfectly free, but the veins and lymphatics contain valves which allow the blood to flow towards the heart, but prevent its return. In the same way

periodic contraction and hardening of the muscles forces the blood out of the veins towards the heart, and the valves prevent its return; thus deep breathing and muscular exercise are important aids to a good circulation of the blood and lymph.

The Blood and Illness The very intimate relation between the blood and every part of the body gives it a large share in all matters of health and sickness. For this reason it was believed for a long time that disorders of the blood were the cause of disease. When a person became sick, it was thought that an evil spirit or some impurities had found access to the blood, and that a cure could only be effected by removing them, hence the custom of blood letting, practiced for many years. Of course, this treatment served only to weaken the patient, and those who recovered were cured in spite of, rather than because of, blood letting. The blood itself is never the *cause* of illness, but in many forms of disease, particularly the chronic and protracted forms, and in all cases of general debility, it is reduced in quantity and altered in quality. The most common example of this condition is anæmia, in which the red corpuscles are reduced in number and their ability to carry oxygen is impaired.

Anæmia The cause of anæmia is generally lack of muscular activity and fresh air. If moderate out-of-door exercise is taken every day, with plenty of sleep, the appetite is increased, more food is eaten and digested,

and the blood is gradually restored to its normal condition, and all symptoms of weakness disappear.

The old idea of impurities in the blood still survives, and is the foundation for the belief that the blood needs to be purified in the spring by taking purgatives and all sorts of "spring medicines." The real cause of lowered vitality, weakness and "that tired feeling" is found in confinement to overheated rooms, late hours, too much food, and lack of out-of-door exercise during the winter months.

RESPIRATION

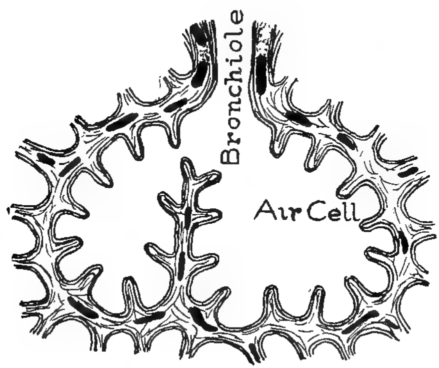
Use of Oxygen in Nutrition

In the "running of the machine" we have considered how the blood is supplied with nutriment and how it is transported to the cells, but for cellular activity *oxygen* is as necessary as nutriment. A fire cannot be kept up without oxygen any more than without fuel. Because the oxygen of the air is everywhere present and invisible, this is not so apparent. The nutriments are useless to the cells without the oxygen to combine with them, and through the chemical union set free the energy necessary for all life processes. Oxygen is the most imperative requirement of the body. Food may be withheld for a week or more and drink for days, but if we are deprived of oxgyen for but a brief interval, life is extinguished.

It it then the *cells* which use the oxygen, the lungs serving only to absorb, and the blood to transport it.

Respiratory Organs

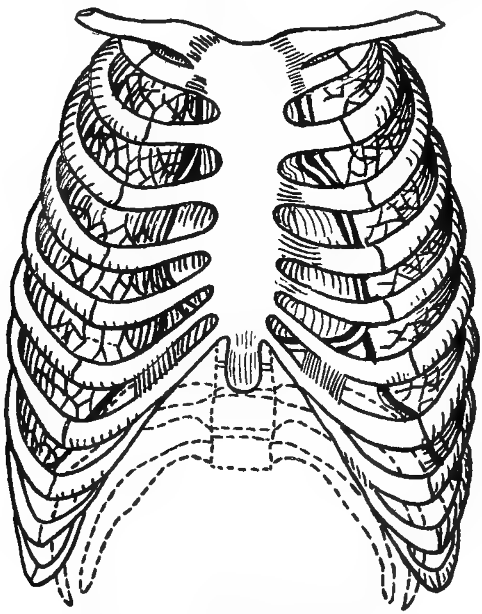
The two openings of the nose unite above the back of the mouth in the space behind the soft palate, called the *nasopharynx.* The nasal space is a high arched dome, having the roof of the mouth as a base. The passages are divided and subdivided into a



AIR CELLS OF THE LUNGS
Redrawn from *The Human Mechanism.*

labyrinth, all lined with mucous membrane. In going through these passages the air inhaled is warmed to the body temperature, and for the most part, freed from dust and accompanying bacteria. The fine hairs in the nostrils strain out much of the dust, and the remainder is caught on the moist surfaces. Certain ciliated cells propel the dust towards the openings of the nose. Through the larynx the air passes to the trachea, which divides into two branches called

bronchi, one going to each lung. The bronchi divide and subdivide, terminating ultimately in small air sacs, having exceedingly thin walls and many cap-



POSITION OF THE HEART AND LUNGS

illaries. Through these thin walls takes place the absorption of oxygen by the plasma and red corpuscles and the elimination of carbon dioxide from the plasma to the air.

The Lungs The lungs contain normally about 200 cubic inches of air. In ordinary quiet breathing we take in about 30 cubic inches and by forced inspiration we may take in an additional 100 cubic inches. We can expel by forced expiration about half the contents of the lungs. If we never use but a part of our lung capacity, the more distant air sacs lose tone and may become closed. This is one of the reasons why deep breathing is necessary.

Breathing Inspiration is accomplished by the muscles of the chest and the diaphragm. The chest muscles increase the depth and breadth of the chest by lifting the breast bone and the ribs. The diaphragm, which is a thin dome-shaped muscle forming a partition between the chest and abdomen, flattens out to some extent and increases the length of the chest. This produces a partial vacuum, which the air rushes in to fill.

The proper method of breathing is of great importance. With men whose clothing often restricts the chest movements, abdominal or diaphragmatic breathing predominates. With women upper chest breathing is usually made necessary by the restriction of the waist from corsets. The natural method of breathing is both abdominal and intercostal.

Adenoids Growths in the nose, as adenoids, may restrict the free passage of air to the lungs and thus make mouth breathing necessary. Nature intended that air should be taken in through the nose and any interference of the nasal passages should be remedied.

It is a common expression that "oxygen purifies the blood." It is true that the carbon dioxide, water and a small amount of other waste matter are eliminated during expiration, but oxygen in uniting with the nutriments of food in reality *vitiates* the blood.

Oxygen Carriers

The plasma is made up chiefly of water which has little capacity for dissolving oxygen so the red corpuscles, with their hemoglobulen, are the chief transporters of oxygen. The hemoglobulen in the presence of oxygen forms a combination, *oxy-hemoglobulen*. This, when it reaches the cells which have used up the oxygen dissolved in the lymph surrounding them, gives up a portion of its oxygen to the surrounding plasma and lymph, whence it is absorbed by the cells. On the other hand, the lymph and plasma have a considerable capacity for dissolving carbon dioxide and quickly absorb that product formed when the oxygen combines with the carbon of nutriments during cellular activity. On reaching the lungs, the plasma loses a portion, but not all, of its carbon dioxide. Arterial blood still contains some carbon dioxide and the red corpuscles and venous blood still contain some oxygen.

Value of Deep Breathing

Under all ordinary conditions the blood has a sufficient supply of oxygen. Deep breathing, or muscular exercise, or even increasing the proportion of oxygen in the air does not cause the blood to absorb more. The value of deep breathing and exercise is not in giving the blood more oxygen, but in making the

circulation more rapid by increase of the number and power of the heart beats. Exercise is about the only natural way of increasing the rapidity of the blood stream, thus making the removal of all waste matter more effectual. Deep breathing, as we have seen, is important in keeping the lungs in good condition and in helping the return of the blood from the veins and lymphatics to the heart.

Effect of Impure Air

The carbon dioxide in expired breath is not in itself poisonous, and recent researches have seemed to show that the organic matters in expired air are not so poisonous as formerly supposed; however, the evil effects of breathing vitiated air are painfully apparent. The harmful effects are probably in the depressing effect on the nervous system rather than in actually poisoning the tissues. Every one knows the effect of fresh, out-of-doors air. We need to get out of doors every day, rain or shine, for as long a time as possible. Man was intended for an out-of-doors animal. Certain burrowing animals, like the woodchuck, may be able to thrive on impure air, but not man at his best. Consumption and pneumonia are essentially house diseases.

Ventilation

The necessity of providing by ventilation a constant supply of fresh air in our houses and especially in sleeping rooms is treated in *Household Hygiene*, and need not be spoken of further. In the winter, good ventilation adds to the fuel bill, but we would not knowingly buy food containing even a small amount

of harmful substances to save ten or even twenty per cent of the cost. Why, then, begrudge the money spent for the more important necessity of the body — pure air? We are very dainty about many things, but why breathe "second-hand air" without a qualm?

NUTRITION

We now come to the question of how the cells of the body make use of the nutrients of food and oxygen brought to them by the blood. Much is known as to the results of the life processes, but a great deal yet remains to be found out about the exact process itself.

Metabolism

Digestion, absorption, assimilation — the building-up process is called *anabolism*, the destruction of nutrients and breaking down of tissues, *katabolism*, and both processes taken together, *metabolism*.

Nutrients

Of the five nutrients — water, salts, proteids, carbohydrates and fats — water and salts yield little or no energy to the body. After use they are excreted in much the same form as they were absorbed. They are, however, an essential part of all living cells.

Water in Nutrition

Without the bones, the body is made up of over three-fourths water, the fat free muscles and glands 87 per cent, the blood nine-tenths. Water is necessary in all life processes for dissolving substances, in the digestive juices, and for carrying away wastes. Water is lost from the lungs, and skin, but more through the kidneys — a total of about three pints

daily in ordinary weather and double the amount in hot weather. The loss is made good in part by the oxydation of the hydrogen, contained in all foods, to water. This may supply about a pint a day. The remainder must be made up by the water in food and by the drinking of water. Water is especially necessary if the diet is high in proteids as some of the products of proteid disintegration are not very soluble. Except in rare disease conditions, there is no danger of drinking too much water, but there is *grave* danger in drinking too little.

Salts in Nutrition

Salts form a part of all living matter, vegetable and animal. The chief salts present in the body are chlorides, phosphates, sulphates and carbonates of sodium, calcium, magnesium, and iron with some others. Common salt — sodium chloride — is the only one purposely added to food, chiefly to bring out flavor. There seems to be an especial craving for it if the diet is largely made up of vegetables. We habitually use more salt than is needed by the body. The excess is secreted in the urine for the most part but the sweat and tears contain a little.

The hydrochloric acid of the gastric juices is made chiefly from sodium chloride, the sodium part of the salt serving to form the carbonate of soda of the pancreatic and intestinal secretions.

In addition to bone formation, the calcium salts are necessary for the coagulation of the blood and the clotting of milk, and with common salt and potas-

sium chloride in the blood, they keep up the regular beat of the heart.

Iron is a necessary part of the hemoglobulen of the red corpuscles. Nearly all vegetables contain iron, but spinach has an especially large proportion of it. Meats and the yolk of egg contain a considerable amount.

In any ordinary diet the body receives a sufficient supply of the salts. Some of them must be present in organic compounds to be of use.

Composition of the Nutrients

The three remaining nutrients, proteids, carbohydrates and fats, all contain carbon, hydrogen and oxygen, but the proteids also always contain nitrogen and sulphur and sometimes phosphorus and iron. The fats have a much smaller proportion of oxygen so they can combine with a larger amount. For this reason they yield over twice as much heat and energy when oxydized as the carbohydrates or proteids.

Use of Proteid Foods

As the living cells are composed almost entirely of proteid material, except for water and a small amount of salts, it is apparent that the body must have food containing nitrogen and sulphur for making good the loss of cell substance which is constantly taking place during activity, and the young require proteid material for the growing tissues. It has been proved many times that without proteid food all animals starve, even if there is an abundance of the other food principles. Moreover, the nitrogen must

be in the form of true proteids — the gelatinoids (often called albuminoids) of which gelatine is a type, and the extractives, although they contain nitrogen and sulphur, cannot take their place. On the other hand, life may be maintained without serious trouble on proteid foods alone, showing that they may furnish heat and energy as well as repair wastes.

Liebig's Theory

As the muscles contain such a large proportion of proteid, Liebig set forth the theory about fifty years ago that proteids were the only source of muscular energy. It has since been conclusively proved by Voit and many others that this was a wrong supposition, and that heat and energy may be supplied by carbohydrates and fats as well as by proteids.

Elimination of Nitrogen

A marked difference between the proteids and non-nitrogenous foods is the fact that the nitrogenous part of proteids, at least, is eliminated by the body as fast as it is consumed; that is, if three ounces of proteid is consumed daily, nitrogen equal to that in three ounces of proteid is eliminated. If the proteid feed be increased to four ounces a day, the nitrogen excreted corresponds to four ounces. It has been found that the body will maintain this "nitrogen equilibrium" on widely varying amounts of proteid in the diet, provided the other constituents are in sufficient amount; and in general that the nitrogen excreted is *irrespective of muscular exercise being taken*. This does not hold in very severe exercise long continued, during which some of the body

nitrogen is used, more being eliminated than consumed.

In going from a low proteid diet to a high proteid diet there is at first a small apparent storage of nitrogen material. This is lost, however, when the diet is changed back to one lower in proteid. The body seems to have little power of storing proteids. If the supply is deficient, it uses its own body proteids. In starvation and in certain diseases the larger muscles waste away, some of their proteid being used to repair cells more necessary for life, as the cells of the heart muscles and nerve cells, and some for supplying heat and energy.

Elimination of Carbon and Hydogen

If the consumption of carbohydrates and fats be increased, on the other hand, there is no proportionate increase of their waste products, but an increase of *muscular exercise* markedly increases the excretion of carbon dioxide coming from the carbon of food products. See page 49.

Storage of Food Materials

When more food is eaten and absorbed than is needed to supply energy and heat, the excess is stored as glycogen and fat. As we have seen, the starches, sugars, and gums are changed by digestion into dextrose, or other simple sugars, and as such absorbed by the intestine, passing first through the portal vein to the liver before reaching the general circulation. The liver, with the help of an enzime, changes a portion of the dextrose into *glycogen* — animal starch. This is changed back again into sugar as it

is needed in the body, a constant proportion of sugar in the blood of the general circulation being maintained. Glycogen is also stored in the muscles and some of the other tissues of the body.

Experiments have proved beyond a doubt that carbohydrates in excess of bodily needs may be transformed into fat and stored as reserve food supply.

Use of the Fats The fats absorbed by the lymphatics are used at once if needed. If the food digested and absorbed is in excess of bodily requirements, fats and the carbohydrates transformed into fat are stored, sometimes between the cells themselves but usually in the connecting tissue, especially that surrounding the abdominal organs and that directly beneath the skin.

The transformation of glycogen into sugar is a very simple one, so this serves as an immediate reserve food supply. It is not known just how the fats are used, but they are taken up by the blood, wherever they are stored, and transported to the part of the body needing fuel.

Oxidization in the Body The oxidation of the sugar by the cells is by no means a simple union of oxygen with the carbon and hydrogen, forming directly carbon dioxide and water. The process is in several stages governed by different enzimes. It is stated that sugar is first changed to lactic acid and this to alcohol, which is finally oxidized to carbon dioxide and water.

How the Cells Use Nutrients One theory is that the nutriments of food are first built into the cells before being oxidized, but most

authorities now agree that it is more probable that the cells make use of the nutriments constantlys urrounding them in the lymph in the same way as the yeast cells use a solution of sugar surrounding them when they oxidize it in their life process.

Reserve Energy

The muscles and glands are not entirely dependent on the immediate supply of nutrients and oxygen brought by the blood. For example, the leg muscles of a frog, removed entirely from the body and its blood extracted, may be made to contract a number of times if the nerves are stimulated by an electric current. The contractions gradually grow weaker with successive applications of the current until they cease. Carbon dioxide and other waste products are given off.

It is not known in what form this energy is stored, but the substance must be in chemical nature something like the explosives in which the oxygen is held in some loose way so that it is able to unite with the carbon and hydrogen of the substance, when a spark or heavy blow starts the action. In the muscles of the body it is the nervous impulse which starts the chemical process.

Use of the Energy of Oxidization

We are not accustomed to think of the oxidation of carbon at a low temperature as we are so familiar with common forms of rapid combustion at a high temperature where light is produced. We are also accustomed to think of heat as being the only form of energy produced by oxidation, but in the electric

battery we have an instance of the energy of chemical union being changed in part into heat and in part into electricity. The body cells use the energy of chemical union of nutrients and oxygen in many ways. In the muscles it is apparent in movement. In the glands the energy is used to transform some of the contents of the blood into its peculiar secretion. In the nerves the energy is transformed into a nervous impulse, and so on. Just how this happens is one of the many mysteries of life processes.

The use of the carbohydrates and fats by the body cells is fairly well understood. They contain only carbon, hydrogen and oxygen, and their *ultimate* waste products are known to be carbon dioxide and water.

Volt's Theory of the Use of Proteids

The proteids are much more complex chemical bodies. The exact way in which the atoms are combined in the molecule is not known of any of them. The way the proteids are used by the body has been a subject of a great deal of study and controversy. One theory is that they are *all* built into the living cells before being used, but, as we have already said, this seems improbable, because of the very rapid excretion of waste products of proteid soon after they are absorbed. The theory of Voit is that they are used from the blood for heat and energy by the cells in much the same way as the sugar, and that the cells use proteids in *preference* to sugar and fats. This has led to the common teaching that other nutri-

ents — the gelatinoids, carbohydrates and fats — are "proteid sparers," in the order named.

Folin's Theory

Recent experiments and analyses made by the physiological chemist, Dr. Folin, at the McLean Hospital, Waverly, Mass., and other workers have led to the bringing forth of a new theory as to the role played by the proteids in nutrition.*

Formation of the Proteid in the Blood

The cells *must* have a certain amount of proteid to make good their substance lost during activity. In digestion the proteids are changed into soluble peptones and simpler bodies, but no peptones are found in the blood. It is thought that the proteids of the blood are built up in the walls of the intestines during absorption. The blood and lymph are richly supplied with proteid material from which, without doubt, the cells make good their loss and new cells are formed.

Nitrogen and Sulphur Split Off

Dr. Folin's experiments seem to show that only a *small proportion* of the nitrogen of the proteids taken in the food reaches the general circulation as proteid, but that most of the nitrogen and sulphur portion is split off during digestion and elsewhere, the nitrogen products changed chiefly to urea in the liver, and the urea and sulphur compounds eliminated from the blood by the kidneys soon after.

Urea contains nitrogen, carbon, oxygen and hydrogen. It is a substance somewhat similar to ammonium carbonate, to which it is easily changed outside the body.

* See article in *Food and Dietetics*, page 196.

The remaining part of the proteid substance — the carbon, hydrogen and oxygen — is changed, perhaps, to sugar and used like sugar. At least, it is known that proteids may yield glycogen. According to Folin's theory, then, the body uses little or no proteids, *as such*, for heat and energy, but their nitrogen and sulphur part is at once split off. The remaining part *only* — the carbon, hydrogen and oxygen — being of use to the body, except for a comparatively small part of that in an ordinary diet which makes good the proteid of the blood used for cellular repair and growth.

Cellular Proteid Destroyed

On a diet of starch and cream, containing practically no proteid, he found that the daily excretion of nitrogen products for an average size man corresponds to about 20 grams of proteid. From this and further experiments he is led to believe that the 20 grams of proteid — about ¾ of an ounce — represents the daily proteid waste of the living cells.

If Folin's theory is correct, and it seems to have been accepted by recent writers, the proteid required for the needs of the adult body *to repair wastes* is much less than was formerly supposed.

Experiments by Professor Chittenden lead to somewhat the same conclusion. While Voit and others taught that about 118 grams of dried proteid are needed daily by an adult man weighing about 150 pounds, Chittenden's experiments have shown that health may be maintained, for months at least, on from 30 to 50 grams of proteid daily.

Low Proteid Diet

Whether or not it is desirable to maintain the body on low proteid diet is another question. The experience of past ages cannot be lightly cast aside. The amount of proteid food recommended by Voit, Atwater and others in standard dietaries is taken from the quantity consumed, on the average, by people free to choose. In some diseases, like consumption, experience has proved that high proteid feeding is very beneficial. On the other hand, the products of proteid destruction are more harmful to the body *if they accumulate,* and their removal involves more labor on the part of the excretory organs than the elimination of the carbon dioxide and water produced when fats and carbohydrates are used.

Uric Acid Formation

The consumption of *meat* increases the amount of uric acid and other "purin bodies" formed, and this is undesirable in diseased conditions like rheumatism and gout. There is no evidence that such diseases are *caused* by uric acid. The proteids of eggs, milk, grains, nuts, peas and beans, do not increase the formation of uric acid. Uric acid is a normal waste product of cellular disintegration. It varies in different individuals. In birds it is the chief excretory product of nitrogen.

Proteids Cannot be Stored Must be Destroyed

There is no conclusive evidence at present that proteids may be converted into fat. It is known that they may be changed to some extent into glycogen, but the body can store only about seven ounces of glycogen, consequently if the body has the maximum

quantity of glycogen, it must use up — oxidize — the proteids eaten and digested in excess of the comparatively small amount necessary to repair cellular waste. It has been found that increasing the proportion of proteid, if the diet is liberal, *does increase the amount of oxygen consumed, carbon dioxide eliminated, and consequently the output of heat of the body, even if there is no increase in muscular work.*

In other words, with the body at rest more heat will be produced and given out on a liberal diet made up largely of meat and other proteid foods than on a liberal diet composed chiefly of starch, sugar, and fat.

It might be stated here that the splitting off of the nitrogen and sulphur from the proteid probably involves the production of a little heat, and that to form sugar or glycogen from the residue some oxidation is necessary; this would account for some of the increased heat production on a diet made up largely of proteids.

Proteids Increase Total Oxidization

Not only is the carbon and hydrogen of proteid oxidized nearly as fast as it is assimilated, but there is apparently greater *total oxidation* in the body. That is, assimilation of proteids stimulates oxidation of the carbohydrates and fats. Just how much this stimulation amounts to cannot be said now. It is probably greater if the external temperature is high. The United States Department of Agriculture, in its nutrition investigations with the respiration calorimeter, is working on this problem, and

the results of the experiments will be available shortly.

There is, then, a marked difference in the way the carbohydrates and fats on the one hand and proteids on the other react in the body. The consumption of carbohydrates and fats is somewhat like the consumption of coal in a hard coal fire. Adding more coal (fats and carbohydrates) does not increase the amount of combustion to any great extent. Oxidation is increased only by increasing the draft (increasing muscular exercise). The proteids are more like some easily combustible stuff, like shavings. When put on the fire (absorbed) they are immediately consumed even if the draft is not changed, and in burning, they cause more of the coal (carbohydrates and fats) to be consumed.

To sum up, the present theories as to the use made of the proteids in the body are about as follows:

Summary of the Use of Proteids

(1) The amount of proteid required for cellular repair is much less than formerly supposed. Moderate muscular activity does not seem to increase perceptibly the cellular proteid destroyed.

(2) Under ordinary conditions, the body has little ability to store the proteids taken in food as *proteid*, nor the residue after splitting off the nitrogen and sulphur as *fat*.

(3) The body must use up the proteid digested about as fast as it is absorbed, excreting the nitrogen chiefly as urea and oxidizing the carbon and hydrogen to carbon dioxide and to water.

(4) Increasing the proportion of proteid in a *liberal* diet increases the heat output of the body and, especially if the external temperature is high, stimulates the oxidation of all the food materials.

TEMPERATURE REGULATION

Man with the higher animals is able to maintain approximately constant temperature through a wide range of external temperature. In the hottest day of summer or the coldest day of winter, the blood registers between 97.5° and 99.5°F. (See *Home Care of the Sick*, page 43.)

Cold Blooded Animals The so-called cold blooded animals — frogs, turtles reptiles, fishes — do not have this power of temperature regulation. Their blood is the temperature of their surroundings or only a few degrees higher. In the cold winter months such animals and some of the fishes "hibernate." Some animals, like the bear and woodchuck, that maintain an even temperature in summer, hibernate during the winter months. They retire to some sheltered place and sink into a deep sleep. Life processes gradually sink and the temperature of the blood lowers to about that of the surroundings. They take no food, but live on their accumulated fat.

Through our ability to keep the body usually at a higher temperature than the surroundings we are able to maintain activity throughout the year, even in the coldest climate, when otherwise we would have to

remain in a half-alive condition through the cold season, like the bear.

Production of Heat

The question arises, how is the heat of the body obtained, and second, how is it regulated? The activity of all the cells produces heat in addition to their peculiar functions. Heat is always one of the products of life. The muscles cannot transform *all* the energy of the chemical union of oxygen and the food materials into the power of contraction. Only 25 or 35 per cent of *digested and assimilated* food can be so used, the remainder being changed into heat. The actively working glands produce much heat; the liver during activity may reach 107°F, but the rapidly circulating blood distributes the heat fairly uniformly, although that coming from the lungs to the heart is about one degree cooler than that from the general circulation. The skin rarely has a temperature over 93°F, and may of course become frost bitten if exposed to severe cold.

Muscular Tone

The work of the internal organs and the friction in the circulation of the blood gives considerable heat, but not enough to maintain the vital temperature of the body *at rest*. This is supplied by a slight unconscious contraction in all the skeletal muscles and the muscles which contract the small arteries. They are under slight tension or "tone" brought about by successive nervous impulses. During cold weather this unconscious muscular tension or tone is greater, giving a greater production of heat. This accounts for

the stimulating effect of cold. As the external temperature is lowered, the muscular tension increases and it finally becomes apparent in shivering.

The heat of the body is lost on the average as follows:

1. By urine and feces................	1.8 per cent
2. By expired air: Warming of air....	3.5 " "
Vaporization of water from lungs	7.2 " "
3. By evaporating from skin..........	14.5 " "
4. By radiation and conduction from skin	73.0 " "

Heat Regulation

We regulate the heat losses to some extent by wearing thicker or thinner clothing, according to the weather, but the chief means of getting rid of a superabundance of heat is through perspiration and the regulation of the flow of the blood to the skin. When active muscular exercise is taken or during hot weather an excess of heat is produced; then the capillaries of the skin dilate, more blood flows near the surface and some of its heat is lost through conduction and radiation. If this is not sufficient, perspiration becomes much more active. The evaporation of liquids, especially water, absorbs and carries away in the vapor a very large quantity of heat. Perspiration only becomes visible when it is secreted faster than it is evaporated.

On a warm day with the temperature, say at 90°F, even when sitting still, the secretion of the perspiration is active and the blood vessels of the skin are dilated to their fullest extent. As the temperature

falls, perspiration becomes less abundant and at about 70° F. almost ceases. Below 70° F. the blood vessels begin to contract, forcing the blood to the interior of the body. At about 60° they have contracted as much as possible and the body has done its utmost to *prevent* the loss of heat. To keep up the temperature of the body more heat must be supplied through muscular activity or warmer clothing must be put on.

Moving air carries away heat rapidly, both by convection and by increasing evaporation.

Effect of Humidity

The amount of moisture in the atmosphere makes a great difference in the heat loss from the body. Moist air is a much better conductor of heat than dry air. On a winter's day when we say the air is cold and "raw", we mean that it contains a large proportion of moisture, and so conducts the heat away from the body rapidly. On a summer day, the air is "sultry" or "muggy" because it holds nearly all the moisture which it is capable of taking up, the perspiration cannot evaporate from the skin rapidly and the body is more liable to become over-heated

Ideal Temperature

In our houses a temperature between 68° and 70° F. is the ideal; then, with ordinary clothing, the blood is evenly distributed between the skin and the internal organs, and there is comparatively little perspiration.

The dangerous temperature is between 65° and 60° F.* If while sitting quietly in a room the tem-

* *The Human Mechanism*, page 201.

perature gradually falls below 65°, the blood vessels of the skin are contracted more and more and the blood is forced into the internal organs and membranes, and the congestion may result in colds or other troubles. If the drop in temperature is gradual it may be unnoticed, whereas a sudden drop would be at once apparent and one would immediately proceed to increase the temperature or put on more clothing.

It is equally dangerous to go from a room temperature of 75° to 80° into the cold. (See *Chemistry of the Household*, page 19.)

ELIMINATION

The waste products of the human machine are its most dangerous enemies. Elimination is fully as important as alimentation and respiration.

Food Wastes

We have seen that the undigested part of food, and the waste portion of some of the digestive secretions, accumulate in the lower part of the colon. Here putrefaction goes on actively. The longer the wastes remain in the colon the more active becomes the decomposition by the bacteria. Some of the products, especially of proteid decomposition, are poisonous. As we have seen, the chief function of the large intestine is absorption. Food, even, is sometimes administered through rectal enema. It is apparent, then, that the accumulated wastes should be eliminated promptly. For most persons unloading of the rectum should take place daily.

Neglect of this internal cleaning is much more disastrous than failure to clean the skin, for the skin is practically non-absorbent, while in the colon absorption takes place constantly. A pasty complexion indicates defective internal cleansing more often than lack of care of the skin.

It is surprising how many people, especially women, neglect this function. The vice of constipation is very prevalent among people whose occupation is sedentary. In addition to rectal troubles, such as piles and hemorrhoids, neglect leads to headache and various minor disorders.

Constipation

The remedy for constipation is not by drugging, but by the removal of the underlying cause, and especially in establishing good habits. Regularity is as important here as regularity of meals. Defecation should take place daily and preferably *at the same hour*, so that the habit may become established. Food eaten should be such as will leave considerable bulk to be eliminated, that is, the diet should contain an abundance of vegetables and fruits, and grains which have not had all of their outer covering removed, such as oatmeal and whole wheat. Fats and oils help in some cases. Plenty of water should be taken; exercise, especially such as work the abdominal muscles and sometimes massage is helpful.

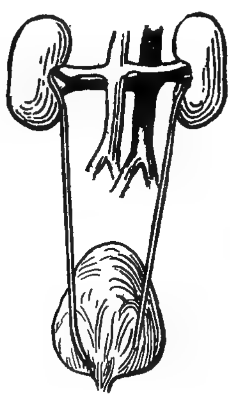
Wastes in the Blood

The organs chiefly concerned in eliminating the wastes from the *blood* are the lungs and kidneys. Carbon dioxide, and incidentally some water, is dis-

charged by the lungs, also a small amount of carbon dioxide passes through the skin by diffusion from the blood in the skin capillaries. The nitrogen and sulphur products of proteid decomposition with water, salts, and many substances in small quantity are eliminated as urine by the kidneys.

Proteid Waste Products

The oxidation of carbohydrates and fats yields only carbon dioxide and water. The proteids, gelatinoids and extractives, in addition to carbon dioxide and water, give urea, kreatinine, uric acid, sulphur compounds and other substances in small quantities.



Kidneys and Bladder.

The Kidneys

The kidneys are two bean-shaped bodies situated on either side of the spinal column in the small of the back. A large artery and a large vein pass between them, both of which send off branches to each kidney. The blood flows from the artery through the kidneys to the vein. The kidney cells have the power of selective absorption and take out harmful and waste products from the blood. They are constantly secreting urine, which passes through the two ureters to the bladder from which it is discharged from time to time.

In general, the secretion of the kidneys—the salts and other waste products, but not necessarily the water — is determined by the blood supply. Thus it is increased by active exercise, during which all the blood is circulating more rapidly.

Cold weather increases the secretion to some extent because the constriction of the blood vessels in the skin throws a greater quantity of the blood to the interior of the body.

Elimination of Water

The amount of water in the blood is kept nearly constant by the activity of the kidneys and sweat glands. If more water is taken than is required, the excess is promptly eliminated. The kidneys must have sufficient water to dissolve the urea and other products, but especially uric acid. This is not a very soluble substance, and is the probable cause of a number of disorders, for which reason and others, it is desirable to have an excess supply of water.

During active perspiration, the skin secretes considerable water and a small amount of urea and other waste products found in the blood. If a large amount of water is secreted by the sweat glands less is eliminated by the kidneys. In certain diseases of the kidneys, the excretion of the urea in the perspiration is increased, but the more important function of the sweat glands is their work in temperature regulation, and not in their elimination.

PERSONAL HYGIENE

Part II

Read Carefully. Answer each question fully. Do not be afraid of writing too fully. Use your own words, so that the instructor may be sure that you understand every point. You are expected to ask questions freely. Leave space between your answers for comments and write on one side of the sheet only.

1. How is energy of the human machine obtained? In what ways is this energy used?
2. What are enzimes and how are they of use in the body?
3. Trace the digestion and absorption into the general circulation of (a) starch, (b) the fats, (c) the proteids.
4. What brings about the secretion (a) of the saliva, (b) the gastric juices, (c) the pancreatic juice?
5. To what extent have we voluntary control over digestion?
6. What can you say of the composition of the blood? (b) How is its proportion of sugar maintained? (c) How is the blood circulated? (d) What would be the effect of a sluggish circulation and what might bring it about?
7. How is oxygen used in the body? Does it purify the blood?
8. Explain fully how oxygen is brought to the cells and how carbon dioxide is eliminated. (b) How is the process made more effective?

9. How is water used by the body? (b) For what are the mineral matters necessary? (c) How are the salts and water eliminated?
10. Why must the body have proteid food?
11. How are the carbohydrates used by the body cells? The fats?
12. Give the various theories as to the way in which proteids are used.
13. Contrast the manner in which the body acts towards proteids and non-nitrogenous foods.
14. In what forms is the body fuel stored? What happens in starvation?
15. How is the temperature of the body kept up and how is it regulated?
16. What are the products of proteid disintegration?
17. Why should the waste matters of digestion be eliminated promptly? (b) By what natural means may a tendency to constipation be overcome?
18. What new facts have you learned in this lesson applicable to the care of your own health?
19. Have you read any other books in connection with this lesson?
20. What questions have you to ask?

Note. After completing the answers, sign your full name

Remember!

THAT ten billions of dollars are expended annually in the United States for food, clothing, and shelter—with greater knowledge and efficiency, better satisfaction could be obtained and one billion dollars saved for higher things.

THAT half a million lives are cut short and five million people are made ill by "preventable" diseases every year—with universal knowledge of hygiene and sanitation nearly all deaths and illness from such causes could be prevented.

THAT six hundred thousand infants under two years end their little span of life yearly, while millions of children fail to reach their best physical development because their mothers and fathers understand not how to care for them in the light of science—with more knowledge at least half the number of babies could be saved and the physical standard raised immeasurably.

THAT thousands of homes are wrecked, tens of thousands of lives are ruined, and hundreds of thousands are made unhappy because the home-keepers of our country have no training in the greatest of all professions, the "profession of home-making and motherhood"—only through such education can present domestic difficulties be solved and the modern home contribute all that it should to happiness and well being.

THAT all must live in some sort of a home—that everyone finds his chief happiness there—that character is developed there—that no great advance, spiritual or material, is possible which does not begin with the home—that the home-makers of America have the making of the nation.

THAT on the breadth and strength of the base depends the height of a pinnacle—on the home foundation we rear the pinnacle of all that is good in state or individual.

—*American School of Home Economics*

PERSONAL HYGIENE

PART III

Care of the Machine

Personal Hygiene Not Yet a Science

DOUBTLESS because our instincts guard us in many ways and because it is only the application of physiology, the subject of Personal Hygiene has not yet reached the stage of a science or even a well-defined art. The application is often hard to make. Medical schools teach the science of the relief of illness, but the care necessary to keep the body in health is usually considered only in brief series of lectures. There are numerous technical books on anatomy, physiology, medicine, sanitation, but at present none on Personal Hygiene. The progressive physicians are true practitioners of hygiene instead of merely prescribers of drugs. "Preventive medicine" has a great future.

So far we have considered the human body as a living machine, and learned how it is operated. A little has been said in passing on the care of the machine, but what has gone before, while more or less interesting, is important only in relation to the care of the machine. It is, of course, necessary to understand a mechanism to know how it should be cared for.

Reasons Not Rules

Mere general rules of health are of little value. We seldom follow such unless we understand the reasons for them, or realize the sure penalty, near or remote,

of their infringement. Happily the day is past when poor health was a distinction; still the majority feel that illness is a grievance and not direct retribution for our physical sins of omission and commission, as it usually is. Here, it is true, "the sins of the fathers are visited on the children unto the third and fourth generation." The adult body is rarely a perfect machine; through inheritance, accident, or lack of proper care in youth some function or organ may become impaired. We all have our physical limitations, but how few of us live up to such limitations! When will physical ills be as much of a reproach as moral ills, and when shall we regard as nearly equal the "Physical health scorning disease and mental health scorning sin."

HYGIENE OF THE NERVOUS SYSTEM

Nervous Demands of Modern Life

Modern life has undoubtedly greatly increased the demands made on the nervous system. The introduction of rapid transportation, newspapers, telephone, keener competition in social and business life, many and varied interests, all have increased nervous wear and tear. The majority live more rapidly than two generations ago. All this calls for a strong nervous system, but a strong nervous system is built up only by education and use and maintained only by use and a healthy body. The brain can accomplish an immense amount of work if it is supplied with good blood and given sufficient rest and relaxa-

tion. It is worry, poor nutrition and lack of rest that most often cause nervous breakdown—not brain *work*.

Importance of the Nervous System

As the nervous system controls every function of the human machine, its care is of the greatest importance. When damaged, repair is always a long and difficult process, for its impairment throws out all the functions of the body. All the organs are subject to fatigue, and require a period of rest. The muscles cannot contract continuously, the stomach cannot always be engaged in digestion—there is even a period of rest for the heart between beats. Because of its great complexity, rest is absolutely necessary for the nervous system, especially the higher nerve centers making up the brain. This rest the brain obtains only in sleep,—perfectly only in deep, dreamless sleep.

Change of occupation gives rest to a part of the nervous system, as for example changing from mental work to physical activity; but each muscular contraction calls for nervous impulses and so adds to general fatigue. Most often this is desirable, for general fatigue brings about sound sleep.

Sleep

We must sleep periodically probably because the wastes of the body accumulate faster than they are eliminated. During sleep nearly all the organs are less active and the wastes are eliminated faster than they are made. The muscles store up oxygen and nutriment, the glands build up substances out of

which they make their peculiar secretions, the nerve centers store up energy and all the cells are repaired.

Conditions in Sleep

During sleep respiration is slowed down and deepened, the breathing is more intercostal; the heart beats somewhat more slowly; the muscles are relaxed; less blood flows through the brain and more through the skin. "It is sometimes stated that the digestive secretions are diminished during sleep, but the statement does not seem to rest on satisfactory observation, and may be doubted." * * * "On the whole, however, the physiological activities of the body go on much as in waking conditions." (Howell.) It is chiefly the *brain* which sleeps.

Amount of Sleep

Most people require eight hours of sleep, others nine, although for some seven hours seems to be sufficient. It is said that women need an hour longer sleep than men, but that probably depends upon the individual and habit.

Soundness and Effect of Sleep

The depth of unconsciousness increases to between the first and second hour of sleep, and then gradually diminishes, although towards morning it increases slightly again. Sleep is more sound in a darkened room, and when there is quiet. Sleep is not nearly so deep during restlessness. To have the greatest effect, sleep should all be taken at one time; several periods equaling eight hours do not give nearly as much recuperative effect as the same period at one time. If one is constantly disturbed during the night more sleep is required.

The question of naps depends upon the general health and conditions. Those subjected to great nervous strain, or those who are weak are much benefited by a brief nap, but people in robust health should have a nervous system sufficiently strong to make naps unnecessary. The nervous system is strengthened through use, just as the muscles are trained by exercise and the stomach by eating food (in moderation) that requires strong digestive power. If one is under special strain, a brief nap gives refreshment all out of proportion to its length. Naps cannot, however, replace the long sleep at night, and they should not interfere with it. Momentary relaxation also gives a recuperative effect out of proportion to its length. **Naps**

The necessity of good ventilation at night has already been spoken of. An increasing number of people are making a practice of sleeping out of doors under sheltered porches, especially in summer time. What is good for the upbuilding of consumptives should prove of equal value in helping minor troubles or in maintaining health.

The temperature of the sleeping room should be brought down to what it can be maintained throughout the night; then the bedding can be arranged to suit the temperature.

Heavy bedding is undesirable. Woolen blankets give the greatest warmth for their weight and "down puffs" are much superior to the heavy cotton quilts **The Bed and Bedding**

or "comforters." The typical white bed-spread is heavy and gives very little warmth. It is best removed or turned back at night. The spring should keep the mattress level. As about a third of life is spent in bed, it pays to get a good mattress. It should be comfortable, but not too soft. For most people, a low pillow is desirable, as high pillows keep the body from lying flat.

Insomnia Sleeplessness has many causes, but it is lack of muscular activity that is most often at the bottom of the trouble. The day laborer, the farmer, fishermen, lumbermen—all who live an active, outdoor life, are not troubled with insomnia. Anything which over-excites the brain is liable to cause sleeplessness. If there is trouble anywhere in the system, the nerves are unduly excited, and as there is intimate connection between all parts of the nervous system, the brain is affected. Indigestion is a frequent cause. The use of tea, coffee and even cocoa at night often causes sleeplessness. Those who go over in the mind the activities of the day—lie in bed and think and think, are troubled with sleeplessness. Sleep depends much on habit. Those who have acquired the habit of not going to sleep easily, find it hard to break themselves of the habit. Regularity as to the time of going to bed is a great help in establishing good habits of sleep. If one goes to bed at all hours, it is increasing the difficulty to drop off to sleep immediately. Sometimes the

trouble comes from the inability to relax the muscles completely. This power needs to be cultivated.

The only means of overcoming the vice of sleeplessness is the removal of the *cause*. The *immediate* cause of sleeplessness is most frequently an excess of blood in the circulation of the brain. Anything which will draw the blood away from the brain will prove helpful. The blood supply of the brain is most intimately connected with that of the skin. It is almost impossible to go to sleep if the surface of the skin is cold. Bed clothes should be sufficiently warm, but not *too* warm or too heavy. Any action which will cause the blood vessels of the skin to dilate will diminish the flow of blood to the brain. Thus, warm baths are apt to be helpful or a hot foot bath with a cold cloth at the back of the neck; light physical exercise will draw the blood to the muscles and skin. Taking a little easily-digested food, if the stomach is in good order, will often draw some of the blood from the brain. If indigestion is the cause of sleeplessness, effort should, of course, be directed to improving that. A light meal should be taken at night in such cases.

To Induce Sleep

If study or other mental work *must* continue until bed time, light exercise for ten or fifteen minutes such as a walk of half a mile out of doors, will be conducive to a good night's sleep.

Preparation for bed should be a leisurely process, so that the mind may get into the proper condition

for sleep. The cares of the day must be banished. It is well to avoid lying awake in bed, and thus establishing the habit. If sleep does not come after ten of fifteen minutes, it is better to get up again, take a few gymnastic exercises, or in some way get the mind in a condition for rest, care being taken not to become chilled. Sometimes the repetition of numbers, monotonous phrases, counting the respirations while breathing deeply, and the like, may induce sleep.

Physiology of Habit

The whole question of habit depends on the nervous system, and this plays a large part in the daily life of every one. A habit is a more or less automatic act which is repeated frequently, requiring each time less effort from the will to accomplish it easily. The process of acquiring a habit may be likened to the making of a path through a heavy fall of snow. The first person to walk through the deep snow does so slowly, and with great difficulty. The second person finds it easier to follow the tracks already made, than to make new ones. All who come after, find the path smoother and easier to travel, and would not think of going into the deep snow on either side. In the same way, the acts performed by the body develop an easiest path along certain routes of the nerve tissue and the act is performed automatically. This is true of the mental as well as the physical habits. The ease with which a habit is formed depends upon the softness and the plasticity of the

nerve tissue; the younger the person, the easier are the habits formed. Nearly all personal habits are formed before the age of twenty or twenty-five. It is increasingly difficult to form new habits after the age of thirty, and it is, therefore, essential that we form right habits of eating, breathing, sitting, standing, sleep, and so on, as early as possible. Considerable strength of mind and long persistence are required to break oneself of an evil habit.

HYGIENE OF FEEDING

We have already considered the digestion and use of food. There remains to be spoken of the how, what, when, how much to eat, and the care of the organs of digestion.

Digestion may be said to commence with the gathering and refining of food stuffs, and to be continued by the art of cookery, which helps to make food soluble and appetizing, but the first necessary part of digestion in the body is mastication.

CARE OF THE TEETH

Degenerate Teeth

The art of preparation of foods and the art of cookery in removing hard substances and softening foods has diminished the necessity for powerful mastication, so that the teeth of civilized people are softer and more liable to decay than those of primitive people and animals. It is a law of nature that organs or functions not used tend to degenerate, hence special care of the teeth is necessary to preserve them.

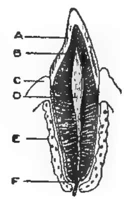
Parts of a Tooth

A tooth consists of the crown, projecting in the mouth, the root in the gum and the narrow portion between, called the neck. The greater part of the tooth is made up of a hard, bony substance, called dentine. On the top and sides the dentine is covered with the very hard polished enamel, which serves for protection. The root is covered with a grayish substance called cement. In the center the cavity

is filled with blood vessels and a nerve, which enter through a small opening in the end of the tooth.

Permanent Teeth

The thirty-two teeth of the adult begin to replace the first set of "milk teeth" at the sixth to eighth year. The four innermost permanent teeth — the wisdom teeth — do not appear until some time between the fifteenth and twenty-fifth year; in some cases they do not come at all. They usually are very soft, and decay easily.



A TOOTH

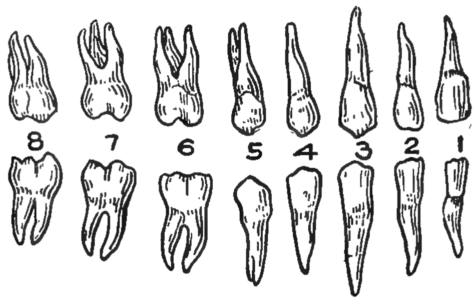
A, Enamel; *B*, Dentine; *C*, Gum; *D*, Cavity; *E*, Jaw Bone; *F*, Cement.

Irregularity in the teeth is usually due to lack of development of the jaw or to extra large teeth coming early. The teeth of a child should be watched, and if they tend to form an irregular line, the dentist should be consulted at once. He may find it advisable to extract one tooth and thus allow those remaining to come in evenly. Especially while the teeth of the child are developing, the diet should contain some foods, like crusty bread and hard crackers, that will tend to develop strong teeth. In a grown person, even, much may be done to strengthen naturally soft teeth by providing food which requires vigorous mastication.

Although the miller and the cook give us soft bread instead of the hard, coarse, ash-cake of primitive people. and the art of stock raising and of the butcher give us tender meat, instead of the tough

flesh of the wild animals, the food must be insalivated and finely divided to make digestion in the stomach quick and thorough. The chief work of grinding comes on the molars, of which there are twelve,

Grinding Power



HALF SET OF UPPER AND LOWER TEETH

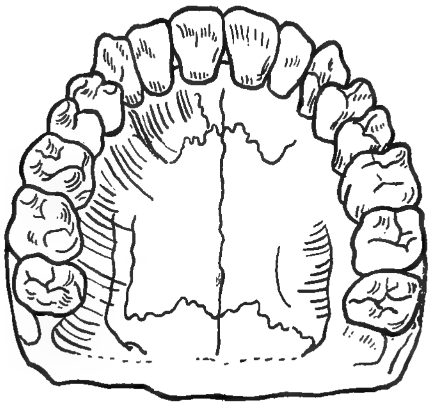
1, First Incisors; 2, Second Incisors; 3, Cuspids or Canines; 4, First Bicuspids or Stomach, 5, Second Bicuspids; 6, First Molars; 7, Second Molars; 8, Third Molars.

counting the wisdom teeth. These are very often lost early, leaving only eight. The loss of only one of these diminishes the grinding capacity *one-fourth*, for the opposing tooth is of little use. The loss of two molars may lessen the grinding power by one-half. The triumphs of American dentistry are such that the loss of a few teeth or even an entire set is not regarded as a serious matter by most people, yet poor teeth are responsible for a much greater proportion of digestive troubles than is often supposed. A good dentist can accomplish wonders, but he can-

Indigestion and Poor Teeth

not equal nature's providing, any more than a false foot is equal to the natural member.

Many theories have been advanced to explain the cause of caries or decay, but it is now well established **Causes of Decay**



COMPLETE SET OF UPPER TEETH

that the main cause is in some way connected with the growth of the various micro-organisms lodged between the teeth. As long as the enamel is intact and the neck not exposed, decay does not begin readily, but if the bacteria find lodgment and food, the fermentation and decomposition caused by their growth tend to injure even the enamel. Once the enamel is broken, the decay of the dentine goes on rapidly.

Preserving the Teeth

It is safe to say that if the growth of bacteria on the teeth could be prevented entirely, even the weakest natural set could be preserved. Absolute cleanliness is the most important preventive to decay; next comes maintaining a high degree of polish so that the bacteria will find no place of lodgment. The practice of picking the teeth with pins or other metal instruments tends to crack the enamel, and thus expose the dentine to the action of bacteria. Biting of hard substances, as in cracking nuts with the teeth, or the constant biting off of threads may have the same effect. Decay is favored by the exposure of the neck of the tooth when the gums are loosened or pushed back by the injudicious use of the tooth pick or a stiff bristle brush.

Tooth Brushes

A good brush is the most effective instrument for cleaning the teeth. The bristles should be stiff, but not *too* stiff, set not too close, and the tufts on the end should be a little longer to facilitate brushing between the teeth. The brush should be discarded when the bristles become spread and so apt to irritate the gums.

Use of Tooth Powder

Precipitated chalk is one of the best powders to use, because it is sufficiently coarse to produce some scouring action and cleanse thoroughly, yet not hard enough to injure the enamel. Powdered soap, orris root, and flavoring may be added if desired. The brushing should be forward and back, and up and down between the teeth. The inside of the teeth

should be brushed as carefully as the outside. The brush should be used, if possible, after every meal, and especially before going to bed at night. The night cleansing is most important, for during the hours of sleep the bacteria have a long period of uninterrupted activity. The mouth provides the most favorable condition for bacterial growths — moisture, warmth and darkness, and if there is food present, they multiply enormously. When it is known that with some kinds of bacteria a new generation may be formed every twenty minutes, it is not surprising to learn that by morning *the uncleaned mouth may contain literally millions of bacteria.* No wonder that many are reminded by the condition of the mouth to use the brush in the *morning.*

Cleaning the Teeth

At night, then, the teeth should receive their most thorough toilet. The use of the brush and powder alone will seldom remove all the food between the teeth and a fine silk thread, or better, the so-called "dental floss," should be pulled back and forth between close-set teeth, care being taken not to injure the gums. To preserve the polish of the teeth and to prevent the accumulation of sordies — tartar— an orange wood stick, cut in the shape of a chisel, should be rubbed up and down between the teeth, with a little powdered pumice stone, several times a month.

Use of an Antiseptic

After cleansing the teeth thoroughly the mouth may be rinsed with an antiseptic solution. This

checks the growth of the bacteria somewhat, but is ineffective if food is left between the teeth. Any of the common mouth washes, such as listerine diluted with an equal quantity of water, may be used; Seider's antiseptic tablets are convenient. While thus cleaning the mouth, it is well to gargle the throat, as this tends to prevent throat troubles.

Visiting the Dentist

It is economy of money, time and pain, to say nothing of the appearance of the teeth, to visit the dentist frequently. He should examine and *clean* the teeth at least once every six months. If the teeth are subject to decay, it is best to go once in three or four months. The thorough cleaning which only a dentist can give is important, for small cavities easily filled, are frequently discovered which would otherwise pass unnoticed and become very much larger. Properly done, the cleaning can do no harm, and the high polish will lessen the chances of food and accompanying bacteria finding lodgment. Sometimes slight defects in the enamel can be treated with nitrate of silver or otherwise without filling.

Fillings

Of fillings gold is the most permanent, the amalgam or silver filling darkens the teeth and can be used only where it will not be seen. The ideal filling would be cement if a substance could be found which would be permanent. With other kinds of fillings, the cavity must be "under cut" to hold the filling in. Cement has sufficient adhesion so that the undercut is not so necessary, and not nearly as deep an excavation need

be made. When the teeth are very soft, cement may prove the most economical filling even if it has to be renewed every year or two.

WHEN, HOW MUCH AND WHAT TO EAT

The composition; nutritive value and digestibilty of food have been treated in the lessons on *Food and Dietetics*, but it will be well to look at the subject from a different standpoint here.

Meals

By providing us with a stomach, nature evidently intended that we should take our food in meals. Some of the working people of the European nations partake of food five times daily, and those who attend the theater and late entertainments often may add an extra meal at midnight, but for most of us three meals a day seems to be the best plan. The stomach usually empties itself in about four hours, so that breakfast between 7 and 8, lunch between 12 and 1 and dinner between 6 and 7 gives it some rest between periods of activity. It needs this rest, for the stomach is not a continuous performance organ, like the heart. Moreover, stomach digestion goes on in stages. As the "psychic" or appetite juices decrease, the secretion brought about by the products of digestion continue, and the juice secreted is *adapted to the food being digested*. Eating between meals may upset the balance.

Eating Between Meals

If one is really hungry, there is no objection to taking a little simple food *once* between meals, pro-

vided it does not interfere with the appetite at the regular meal time. It is the constant eating of candy, etc., to gratify the sense of taste that is disastrous to appetite and digestion. Young children usually need a lunch between meals. When a child is willing to eat bread and butter, it is probable that he needs food. Those of weak digestive power usually manage the same amount of food in four or five meals better than in three.

Regularity as to meal time is important. If for any reason one goes much over the regular meal time, the appetite may be too keen and there is an inclination to overeat and eat too rapidly, with resulting digestive disturbance. Unless there is a regular lunch to prepare, the housekeeper is very apt to become careless and eat at any time or wait until there is a "sinking feeling" in the stomach.

Time for Eating

For the secretion of the digestive juices a liberal supply of blood is needed, so that very active exercise which calls blood to the muscles should not follow directly after the taking of a full meal. *Moderate* activity, like slow walking after a meal, is without much effect, and may be favorable. In the same way, bathing should not immediately precede or follow eating a full meal, but a short cleansing bath has less marked effect on the distribution of the blood than severe exercise and is usually attended with no unfavorable results. We should not take a full meal directly after the loss of considerable water

through perspiration. At such times the proportion of water in the blood is lessened and the secretion of gastric juice is apt to be scanty. We naturally drink water at such times, from the call of thirst, and in fifteen or twenty minutes the blood has regained its normal composition. We should not partake of a full meal when we are very tired, either physically or mentally. A rest of half an hour before eating will put the system in more favorable condition. This is one argument in favor of having the principal meal at night when the active work of the day is over. Then there is time to take the meal slowly with full enjoyment.

How Much to Eat

As to how much to eat, the appetite is the best guide we have. Indeed, an intelligently directed appetite is a very good guide. Pawlow's researches show very clearly how necessary it is that food should be eaten with *appetite.* If the appetite does not call for food, little food should be eaten. As Pawlow points out, however, the appetite may be disarranged because of some disorder or mental condition when the body really needs food. After a few mouthfuls the appetite develops, or as the saying goes, "appetite comes with eating." If there is a continued impairment of the appetite, the warning should be heeded, its cause should be found and conditions changed. Meanwhile, little food need be eaten. The body usually has sufficient stored food material to supply deficiencies for a day or longer if necessary.

Food and Exercise

From the physical standpoint alone, the question of the total amount of food required is determined solely by the heat and energy output of the body. This the United States Department of Agriculture has found very accurately in the respiration calorimeter under different conditions. The outgo beyond a certain minimum depends upon the muscular exercise taken. See table, page 49.

The amount of heat lost is dependent chiefly on the skin surface, for most of the heat of the body escapes through the skin. The weight or contents of bodies increases faster proportionately than the surface area. That is, a small orange has more peel in proportion to its contents than a large orange. The body of a child has a larger surface area than that of an adult in proportion to the weight. A tall thin person has a greater skin surface in proportion to weight than a short, fat person.

Standard Diets

Taking into consideration all these factors, it would be easy from the table on page 49 to calculate to a nicety the number of calories of food required to keep the body in condition, as the fuel and energy value of all foods has been determined. Such calculations, however, would be only of general value, for although rules may be laid down for averages, individuals differ so greatly in the amount of food required that standard dietaries and the like are of little value except for comparison. It is a matter of every-day experience that two persons of about the

Personal Peculiarities

same weight and height and taking about the same amount of muscular exercise need very different quantities of food to keep them in the condition of health. One person may put on fat on a diet which would be insufficient to keep up the body weight of another. Inheritance is a large factor. One person may be able to digest and assimilate a much larger proportion of food eaten than another. It is the amount of food digested and assimilated which is of use to the body.

Nutritive Value of Food

However, people are much more alike than they are different and it is important to know the composition and the nutritive value of foods. The following table gives the food value (fuel and energy value) of a number of common foods *as eaten*: that is cooked, if they are cooked, and without refuse or the inedible part The figures only represent averages for the composition varies greatly, a large proportion of water decreasing the food value and fat greatly increasing it. The value is given in calories per ounce. The volume of a pint equals about 16 ounces and a measuring cup 8 ounces and two level tablespoonfuls about an ounce of many foods. A cubic inch of butter or meat and a slice of bread half an inch thick weighs about one ounce.

FUEL AND ENERGY VALUE OF FOODS AS EATEN

Food	Calories Per Ounce	Food	Calories Per Ounce
Lard, salad oil, etc	250	Indian Pudding.........	52
Butter.................	225	Eggs (boiled)...........	48
Nuts (almonds, peanuts, pecans, walnuts).avg.	185	Fish (baked blue).......	42
Chocolate (bitter).......	179	Baked Beans............	35
Chocolate nut candy (about)..............	140	Bananas................	29
Cheese (cream)..........	123	Grapes.................	28
Crackers and cookies.....	119	Potatoes (boiled)........	28
Sugar...................	116	Macaroni (cooked).......	26
Plain candy.............	112	Hash...................	24
Cake....................	105	Milk (whole)............	20
Lamb (broiled chops)....	104	Apples.................	19
Dates and raisins........	101	Oat Meal Mush..........	19
Beef (roast).............	101	Chicken Soup(home made)	18
Mutton (roast leg).......	89	Peas (green canned).....	16
Olives (green pickled)...	87	Spinach (cooked)........	16
Mince Pie..............	85	Oysters................	15
Ham (boiled)............	83	Oranges................	15
Broiled Tenderloin of Beef	81	Soup Stock.............	12
Apple Pie..............	79	String Beans, Onions Beets, Squash.........	12
Bread (white)...........	76	Musk melon............	12
Bread (whole wheat).....	72	Strawberries............	11
Sweet Potatoes..........	58	Milk (skimmed).........	10
Cream.................	57	Tomatoes and Lettuce...	6
Pudding, rice, tapioca....	52	Celery and Cucumber....	5
		Cereal Coffee (infusion)..	2

Note. From the above table, in connection with that on page 49, it will be easy to get a general idea of the quantity of food required. For example, with eight hours of sleep, six hours of rest, and ten hours of light exercise, a man of a body weight of 154 pounds would require about 2,800 calories. (See page 49.) A woman weighing a little over 100 pounds would need 1,900 calories. This would be supplied by 14 ounces of chocolate candy, or about a pound loaf of bread and three ounces of butter, and so on.

Over Eating

There are many people "blessed with a good appetite;" such are apt to eat too much. Indeed, with abundant food supply, which the art of the cook has made most tempting, and because of rapid eating, very *many people eat too much*, especially those of sedentary habits. We must eat only to satisfy the *demands* of the appetite, not to gratify the sense of taste. It is only one who has much manual labor to perform that needs "three square meals a day." A light breakfast, a light lunch, and a moderate dinner will keep others in a better condition.

If overeating does not ruin the digestion, the person is apt to grow fat, especially after middle life. Although heredity makes a great difference, accumulation of much fat is always a proof that too much food has been eaten or that there has been to little physical activity — usually both.

Reducing Fat

Fat is so much stored food material — lifeless matter. The only way it can be reduced is by oxidizing it in the body — burning it up. This can be done only by lessening the food supply and by taking very active physical exercise. Exercise which produces active perspiration is most effective. Putting on of fat gives a disinclination for active exertion and so the tendency is for the fat to accumulate. Although there is no evidence that fat may be made from the proteid of food eaten, and if the food could be made up entirely of proteids (which is impossible), the amount of fat would not *increase*, but it cannot be

diminished unless the physical activity calls for more fuel and energy than is contained in the food eaten. The diet in obesity, then, would consist of such foods as have low fuel and energy value. A concentrated food means a food that contains little water. Fats have nearly 2½ times as much fuel and energy value as proteids and carbohydrates. Foods that contain a large amount of water are vegetables and fruits, except dried fruits. A certain bulk has to be taken to satisfy the calls of the stomach and to prevent constipation. It is usually recommended that the diet consist largely of proteid foods, especially lean meat. As we have seen, the proteids are quickly burned up. However, if the diet, even made up chiefly of proteids, is *liberal*, sufficient energy will be furnished to the body and none of the body fat will be consumed; consequently the total fuel value of the food is the chief consideration, so far as diet is concerned, if fat is to be *decreased*.

Less clothing should be worn, as low external temperature increases the heat output of the body, and so body fat is consumed if the diet is light. Less sleep should be taken, for during sleep the body uses less than a fourth the energy used in active exercise.

Increasing Fat

The conditions for increasing fat are just the reverse. The diet should be liberal and consist of easily-digested food, with abundance of fats and carbohydrates. Long hours of sleep and rest should be taken; there should be freedom from worry and

nervous wear and tear; clothing and surroundings should be warm; sufficient out-of-door exercise should be taken, to give a *keen appetite*. It is often more difficult to put on fat than to lessen the amount, as heredity has such great influence. A complete change of life may be required to make any difference in body weight.

Winter Diet

Somewhat more food is required in winter than in summer, because of the greater heat output of the body, but if thicker clothing is worn and one is not exposed to any great extent to out-of-door temperature, no more food is needed than in spring or fall.

Hot Weather Diet

During very hot weather the quantity of food should be considerably diminished, especially proteids, and more liquids should be taken so that perspiration may be active and not diminish the proportion of water in the blood.

Heat Stroke

It has been found, strangely enough, that when the external temperature is very high, the body furnishes *more heat than at ordinary temperature*. In other words, oxidation is more active, the bodily fires burn more fiercely. This increase is brought on by the proteids, carbohydrates and fats in the ratio of 20 to 10 to 7. The increased heat production may raise the temperature of the body to such an extent as to cause a "heat stroke" if it is not lost sufficiently rapidly. During hot weather the appetite calls for less food, for much water and succulent vegetables, as salad plants and fruits. It is recom-

mended that the total amount of food eaten should be less in fuel value than the heat output of the body. Under these conditions, some of the body fat is used, which accounts for the fact that most people lose weight during a long period of hot weather. Here is the probable reason that exercise inducing perspiration is found to be most effective in the reduction of weight in obesity.

What to Eat

As to what to eat, again the educated appetite is a trustworthy guide. We should eat the things which we find palatable, for these will have a better chance for thorough digestion. This is not saying, however, that all food eaten with enjoyment will be perfectly digested. When the digestive organs are in good condition, a reasonable amount of all foods that have been found by experience to be wholesome should be disposed of without trouble *provided only*, that the food be properly cooked and properly eaten. No human stomach can be expected to digest pies and doughnuts as they are sometimes made, but they may be so cooked that any one in health should be able to eat *small quantities* without discomfort. The stomach needs some exercise, like all the other organs of the body. The constant eating of easily digested and predigested foods will weaken the digestive organs, just as lack of exercise will weaken the muscles. While the digestive organs should be capable of taking care of small quantities of difficultly digested food, the whole diet should not

consist of foods known to be digested with difficulty. A little fried food occasionally, skillfully cooked, should cause no trouble, but a constant diet of the product of the frying pan may be expected to ruin any digestion.

Digestive Peculiarities

Many people find that certain foods disagree with them at times, such as lobster, sausages, strawberries apples, cucumbers. Such personal peculiarities must, of course, be heeded, but the list of forbidden foods ought to be a small one. Those who will take little or no exercise find their list of indigestible food constantly increasing. It is far better to take sufficient exercise to keep the digestive powers up to a reasonable level.

Omnivorous Tastes

What we like depends upon our education; we usually prefer throughout life the foods which we learned to like in youth. It is desirable that we develop omnivorous tastes while young, for the appetite calls for variety. Children are very apt to acquire unreasonable tastes in food, and while they should not be forced to eat food that is distasteful, still with a little tact, good food habits can be formed. A child will usually consent to eat a *little* of a new food without undue family disturbance if favorite foods are withheld until the mouthful or two is disposed of. After a few times, he will often call for more than a little of formerly despised foods.

Proportion of Nutrients

As we have seen, it makes little difference whether the energy of the body is supplied by fats or by car-

bohydrates or by proteids. If the composition of foods is known, we can safely leave the appetite and experience to the subconscious selection of the proportion needed for the body in *health*.

Amount of Proteid

Recent experiments have shown that in any diet which we would select, if free to choose, we would obtain sufficient proteid to furnish that required for cellular repair, so we need have little fear that the diet will be *deficient* in proteid. We may, however, easily take too much. Although eggs, milk, cheese, beans, and peas contain a considerable proportion of proteid, there is not much likelihood that we shall eat in excess of any of them. The proportion of proteid in *meat* is much greater, and very many people, especially those of sedentary habits, undoubtedly eat too much meat. This comes about because most people like meat, and because it is somewhat difficult to make a good roast or steak unpalatable by poor cooking.

Meat Eating

As we have seen, the proteid foods have a decidedly stimulating effect on the organism. In case of general debility, anæmia, and in wasting diseases such as consumption, this stimulus is just what the body requires, but for those leading inactive lives, there may be too much stimulation. It is only *oxidation* that is stimulated; elimination may not keep pace, and the accumulation of wastes brings about unfavorable conditions. Headaches and other nerve troubles are favored by too much meat eating more often than commonly known.

The diet of the growing child and youth needs to be high in proteid.

Vegetarianism

Vegetarianism has been advocated as a cure-all, and for those who eat too much or whose diet consists too largely of proteids, it is undeniably helpful, but there seems to be no reason (except the ethical argument that man should not take animal life for his maintainance) that all use of meat should be abandoned.

Common Sense in Diet

To quote from Professor Chittenden, whose work gives a strong argument for less meat eating: "I am inclined to emphasize the desirability of using common sense in the application of dietetic rules, remembering that man is an omnivorous animal, and that Nature evidently never intended him to subsist solely on a 'cereal diet,' or on any specific form of food to the exclusion of all others. On matters of diet every man should be a law unto himself, using judgment and knowledge to the best of his ability, reinforced by his own personal experiences. Vegetarianism may have its virtues, as too great an indulgence in flesh foods may have its serious side, but there would seem to be no sound physiological reason for the complete exclusion of one class of food-stuffs, under ordinary conditions of life."

DRINK

Water as Drink

As to drink, pure water is the best drink we have, but impure water is very dangerous as it may pass through the stomach without becoming mingled with th hydrochloric acid, which destroys nearly all dise germs. The living tissue contains nearly nine-t water, *i. e.*, the muscles 87 per cent, the gla the liver, 86 per cent, the blood 90 per ce people, especially women, do not drink water. There is a feeling that water take times will dilute the gastric juices, and s with digestion. Pawlow found that water the few substances that stimulates the secret gastric juices, and it has been proved that a tity less than three pints (an impossible amou rather than hinders digestion. It is well tc glass or two of water in the morning before br one or two glasses with each meal and betweer if desired. The water passes rather quickly the stomach and is absorbed into the blood intestines, and soon after is secreted by the ki Experiments have shown that an imperce amount of energy is required for the absorptio elimination of water, and it has been found increasing the quantity of water increases the am of urea and other waste products eliminated.

Drinking water with meals is favorable to digest but this is by no means the same thing as tak water *with food*. As we have seen (page 53),

foods should be chewed until the saliva has moistened them sufficiently to make swallowing easy, for in addition to the digestive action of the saliva, the taste of foods increases the flow of the "psychic juices." If the food is *washed down* with water or other liquids, it will not have nearly as good a chance of being easily digested.

The temperature of the water does not seem to make very much difference. Ice water is not harmful, provided it is sipped slowly, and so becomes warm before entering the stomach. Hot water is sometimes recommended in cases of indigestion, but in reality the heat has very little effect. It does not cause an increased flow of gastric juice but may increase the movements of the stomach somewhat.

Tea Coffee Cocoa

Of the beverages, tea, coffee, and cocoa, tea and coffee contain the alkaloid caffein and the cocoa a substance very similar, called theobromin. These are substances something like uric acid in chemical composition, and so undesirable in certain disease conditions. For most people a cup of coffee with the breakfast adds to the enjoyment of the meal and for that reason may help digestion. While one cup of coffee may be favorable, two cups may be decidedly harmful. Here, as in all else, temperance should be the rule. Tea, coffee, and to some extent cocoa have a stimulating effect on the nerves. Some people can take coffee and not tea, others the reverse. We

usually know whether tea or coffee is harmful or not, and we certainly should have the strength of mind to refrain from one or the other if we cannot take it with impunity. Few people leading sedentary lives can take either tea or coffee three times a day without harmful results.

Alcohol

Alcohol is commonly regarded as a stimulant. At first it increases the flow of blood to the skin and brain and gives a feeling of warmth and of general well-being. According to the latest experiments, alcohol brings about the increase of the flow of blood to the skin and brain by *inhibiting*, paralyzing, the action of the vasco-constrictor nerves. In the brain it loosens up or gives freedom from restraint. In small quantities alcohol can without doubt be taken without harm, but it is a powerful drug, and as the system adapts itself to abnormal conditions, larger amounts are required to produce its effect and the appetite demands more and more. Large quantities are disastrous to every function of the body. The evils of alcoholic intemperance do not have to be enlarged upon; without doubt the world would be far better off if there were not such a substance as alcohol, even though physicians may sometimes use it to advantage.

HYGIENE OF THE SKIN AND ITS MODIFICATIONS

The skin is the protecting covering of the body, and the hair and nails come from modifications of its structure. The mucous membrane is similar to the skin in structure, but without its outer horny layer. (See page 42.) Although the outer skin contains many "pores," sweat glands and sebaceous glands — it is not *porous*. On the contrary, the skin is practically water tight from the outside inwards. Aside from certain mercury preparations, the skin cannot be made to absorb a material amount of any substance, although the outer covering takes up oils and other matters to some extent. The mucous membrane, however, in some parts is "porous."

The Skin Water Tight

The outer skin is constantly shedding its outer layer of horny cells; the salts dissolved in the perspiration are deposited on the surface and in the mouths of the sweat glands, the oily material secreted by the sebaceous glands accumulates, and may stop up the opening, causing pimples; and the secretions contain odorous substances; so for health and decency bathing is required.

BATHS

Cleansing Bath

The chief use of the bath is for cleanliness, but it may also have other hygienic effects. The frequency of bathing from the standpoint of cleanliness depends on the occupation and environment. Some people require a daily cleansing bath, while with others one or two

a week is sufficient. Too frequent bathing with soap and warm water may have unfavorable effects, as it is not well to carry away all the oil of the skin which is needed to keep it soft and pliable.

Effect of Different Kinds of Baths

The stimulating effects of bathing depend on (1) the temperature of the water used, (2) kind of bath, (3) the time of day, and (4) the duration of the bath.

(1) Very cold water produces a shock and either depresses or overstimulates, according to the strength of the individual. Hot water always produces a sedative and depressing effect. Cool water produces a tonic effect, and from a hygienic standpoint, is the only temperature that should be used for bathing. The degree of coolness which will produce the greatest benefit varies with different individuals and in different seasons.

(2) The kind of bath used depends on the volume and the force of the water, which comes in contact with the body. Great force and large volume produce a shock, and thus tend to overstimulate. The douche, large shower with high pressure, and the plunge, represent baths with great force and large volume of water. Applying water to a small surface at a time, as in a sponge or hand bath, produces only local effects, because the volume and the force are not sufficient to stimulate the whole body. A needle spray, mild shower, or a sponge bath with a very large sponge tend to produce general tonic effect.

(3) A bath taken just after rising, when the func-

tions of the body are greatly reduced in activity, will produce far greater effects than later in the day after some vigorous muscular exercise.

(4) A cold shower bath of two minutes' duration would ordinarily have a tonic effect on a healthy individual after exercise, but the same bath continued for eight or ten minutes would have a decidedly depressing effect. A warm bath of five minutes' duration would have a soothing effect, but if continued for ten or fifteen minutes it would prove depressing.

Stimulating Baths

We have, then, four important principles governing the question of bathing. These principles are closely related and overlap each other. For example, a plunge in luke-warm water in the early morning would not stimulate any more than a cold sponge bath at the same hour, and a cool sponge bath in the early morning would produce as much effect as a cold shower or plunge bath in the late afternoon. Knowing the general effects of temperature, pressure, and volume of water, time of day, and duration of bath, we can arrange the conditions with a view to securing a tonic effect. It is impossible to lay down rules for everybody, but, fortunately, every one can find out for himself what is the temperature, kind of bath, and duration of bath which will be most beneficial for him. This is shown by the after-effects of the bath. If the bath has produced a tonic effect, the individual will feel warm, wide awake, comfortable, and ready for work, and there will not be a

reaction of depression one or two hours later. On general principles, the most favorable conditions for a daily hygienic bath would be a cool or cold shower bath, following some vigorous muscular exercise about five o'clock in the afternoon. If the bath is taken immediately after rising, the temperature, volume, and force of water should be moderate.

The Morning Bath

Most people are benefited by a cool bath every morning. While it takes considerable courage to indulge in a tub bath of very cold water, it is not necessary that the water be of the same temperature as it comes from the tap. Although a tub or shower bath is not available for every one, all having a bowl of water may indulge in a sponge or hand bath, and the brisk rub afterwards. The stimulus of the reaction sends the blood coursing through the system, the respiration is deepened, and the active exercise of rubbing gives one a good start for the work of the day.

Salt Water Bathing

Salt water bathing is supposed by most people to be more beneficial than fresh water bathing, because of the presence of salt in the water. It is true that sea bathing is more exhilarating than lake or river bathing, but the exhilaration comes from the sea breeze, the greater coolness of the water, and the movement of the waves; the presence of salt in the water has no effect. The use of rock salt in the bath tub at home is a waste of time and money.

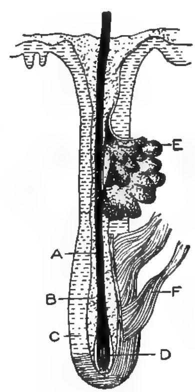
Sun Baths

Another most valuable tonic for the skin is the sun bath. The effect of the sun's rays on the skin

is appreciated only by those who have tried it. The skin should be exposed for a short time at first, in order to avoid burning. Gradually the time may be increased, until the skin is of a rich brown color. The good effect of sun baths is not limited to the skin, but the whole body, and the nervous system in particular, is greatly benefited.

CARE OF THE HAIR

The hair and hair sheath are both modifications of the outer skin. Each hair root has a small network of blood vessels supplying it with nourishment. The skin forming the scalp is very thick, owing to its large number of hair roots and blood vessels. The amount and quality of the hair, like nearly all the physical characteristics, is largely a matter of inheritance. Its condition depends indirectly on the general health and directly on the circulation in the scalp. When the scalp is thin and tightly drawn, the circulation of the scalp is apt to be poor, the nourishment of the hair roots inadequate, and the hair suffers. Sometimes the amount of the hair diminishes rapidly in a few weeks because of acute illness or a general low condition.



A, Hair; *B*, Sheath; *C*, Folical; *D*, Hair Root; *E*, Sebaceous Gland, *F*, Muscle.

With the return of general bodily health, the hair roots secure sufficient nourishment, and the hair resumes its normal growth.

Dandruff

The presence of dandruff is perhaps the most common accompanying condition in the falling of the hair. Cleanliness is absolutely essential to the health of the scalp, and dandruff is an indication of poor condition. The best way to keep the head free from dandruff is by the use of a stiff brush night and morning, and by washing the scalp with soap and water two or three times a month, or as often as necessary. A stiff brush should be used for brushing the hair, with the bristles far enough apart to allow of the brush being easily cleaned. Three to five minutes, vigorous brushing night and morning will prevent dandruff from accumulating, and will stimulate the circulation of the blood in the scalp. If the scalp is very tender, a softer brush should be used. The comb should have long, blunt teeth, set not too close together; sharp, rough teeth tend to scratch the scalp and injure the hair.

Brushing the Hair

Some people hesitate to comb or brush the hair, any more than is absolutely necessary to dress it, because by so doing some of the hair comes out. If the right kind of a brush is used with gentleness, the hair which falls in brushing and combing is practically all dead hair which ought to be removed.

Shampooing

The frequency of shampooing depends on the individual. With some, once a month is often enough,

and others require a thorough washing once a week. Any good toilet soap will serve the purpose. The scalp should be rubbed thoroughly with the ends of the fingers, care being taken not to scratch with the nails, or a stiff brush like a nail brush may be used. The soap should be washed out completely with warm water, and the head rinsed with cold water, to avoid taking cold. The hair must be dried thoroughly with towels and finally held near a register, or preferably in the sun.

A certain amount of oil is necessary to keep the hair soft and in good condition. The oil glands in the scalp usually secrete a sufficient amount for this purpose. It is sometimes thought that frequent washing of the scalp will remove all the oil and make the hair too dry. This is not usually the case, because the rubbing and cleansing stimulate the oil glands to greater activity. The application of oil or vaseline is advisable only when the hair is very dry.

Massage of the Scalp

Aside from cleanliness, massage is about the only effective method of stimulating the growth of the hair. For the best results, massage should be applied for about five minutes every day. A long application at infrequent intervals has very little effect. The ends of the fingers of both hands should be applied to the scalp as closely as possible and rubbed gently backward and forward, alternating with a circular movement, care being taken not to pull too

hard on the hair. At times the scalp itself should be moved over the bones beneath.

Electricity has been recommended as a stimulant to the scalp. If used judiciously it may increase the circulation to some extent, but the results obtained are no better than massage, and hardly warrant the inconvenience and expense. The same may be said of vacuum caps.

Hair Tonics Innumerable hair tonics are advertised in superlative terms, but the only benefit to be derived from them is the little massage involved in the application of the so-called tonic. No drug can be absorbed by the skin in sufficient quantity to produce much effect.

Cutting and Singeing Cutting and singeing have been recommended to increase the growth of the hair, but there is no evidence that this has the slightest effect. Split ends of long hair should, however, be trimmed off.

Curling the hair may injure its quality and appearance by pulling too hard on the roots, or in using the curling iron too hot. If the hair is not pulled o burnt, curling does not seem to injure it.

Superfluous hair on the face can only be removed permanently by means of electricity. If done properly, this method is painless, the root is destroyed, and the hair never grows again.

Gray Hair The time when the hair grows gray depends largely on inherited tendency, but this change is hastened by mental strain, worry, overwork and unhygienic

living. Occasionally some great sorrow or nervous shock will cause the hair to turn gray in a short time. In rare cases its color may return with improvement of the general health. There is no drug or remedy applied externally or taken internally which has the slightest effect in preventing the hair from turning gray.

CARE OF THE COMPLEXION

Complexion and Health

A clear, healthy complexion is an indication of good digestion, good circulation and good elimination, and is to be obtained and kept only through attention to the general health. The skin of the face is both delicate and much exposed, so its care calls for special attention. Here as elsewhere cleanliness is essential to the health of the skin. As to how often to use soap and water depends upon conditions. In a soft coal city and in dusty places soap must be used. There is some danger of removing too much of the oil of the skin if the face is washed too frequently with soap and warm water. Soap may be used on an oily skin with advantage more often than on one which has a tendency to be dry.

Washing the Face

It is probable that moderately cold water is best for general use. The cold stimulates the muscles of the face and the blood vessels of the skin, and keeps them in good tone. Only clean, soft water should be used, and the wash cloth must be absolutely sweet and clean. Whenever soap is applied

it should be thoroughly rinsed off with cold water. If the skin is apt to be dry, an application of an oil substance, such as cold cream, will prove helpful.

The best time for thorough cleansing with soap and warm water is probably at night before going to bed. Then the skin will not be exposed to cold, and by morning the protecting oil secretion will have been restored. Any good toilet soap may be used; medicated soaps are of little value. The price is a fairly good indication of the care with which the soap has been made. Transparent soaps usually contain glycerine.

Steaming the Face

For a thorough cleansing, a thick cloth like a Turkish towel may be wet in hot water and laid over the face. This, in addition to softening the tissues, induces perspiration, which tends to clear out the sweat glands. This may be followed by an application of cold cream, well rubbed in. On wiping off the cold cream with a soft cloth the amount of dirt removed will often be surprising. This treatment should be followed by an application of cold water to contract the blood vessels of the skin.

Massage of the Face

In addition to the stimulating effect on the muscles of the face of cold water, massage with cold cream is very helpful in improving the circulation. The tips of the fingers should be used with a rotary, upward and outward movement, the lines and wrinkles being always rubbed across. The touch should be firm, but gentle. To have much of any effect,

massage must be practiced for a few minutes every day.

Cold Cream

Cold cream is a mixture of white wax or spermaceti and some oil, as almond oil or castor oil, to which some fragrant substance is usually added. Lotions and creams usually contain glycerine and a great variety of substances, some of which are harmful.

Face Powders

Face powders are made of talc, starch, bismuth, zinc oxide, chalk and magnesia, and as a rule are harmless if applied in moderate quantity for a short time and thoroughly washed off. Powder is white dirt instead of black dirt; it has the same effect as the application of so much graphite — the principal ingredient of stove blacking — which has about the same physical properties as talc.

Pimples and the Blood

Pimples are most often caused by some microorganisms, usually bacteria, finding access to the skin in dirt through some small break or through some gland. The pus which they contain is made up, among other things, of the dead bodies of white corpuscles which have perished in their endeavor to rid the skin of the intruders. A boil is an enlarged pimple. Their discharges are somewhat infectious. In general, pimples and boils do not represent the efforts of the blood to free itself from the impurities, but if the blood is in poor condition, by reason of faulty elimination or indigestion, its protecting power is lessened and skin troubles are more apt to manifest

themselves. Skin diseases are many and complex, and they should be treated by specialists.

Blackheads are the hardened secretions of sebaceous glands. They may be softened by the application of cloths wet in hot water and removed by pressing the skin gently between the balls of the thumbs.

Care of the Hands

Some care is required to keep the hands in good condition, especially if much housework is done. Stains and dirt should be removed as soon as possible, so that they may not become deeply imbedded and require rough treatment for their removal. Crude soaps contain free alkali, and when used in hot water remove all the protecting oil, making the skin hard, dry, and apt to crack open or chap. Only a good grade of white soap should be used in dish-washing and the like, if the appearance of the hands is to be considered. The hands must be kept out of hot water and soap and soda when possible, and should be dried thoroughly at once after being wet. When it is necessary to use strong soaps and alkali, rubbing vaseline or oil into the hands previously will help. Thin rubber gloves may be used, but they are very uncomfortable and clumsy.

The nails should be kept clean not only for appearance sake, but because the dirt may harbor dangerous infection. The nail brush, orange-wood stick and nail file are better to use than sharp instruments. If the nails are brittle and so-called hang-nails form, nightly treatment with cold cream for a few weeks should bring about improvement.

CARE OF THE MUCOUS MEMBRANE—COLDS

Cause of Colds

Inflammation of the lining of the upper portion of the respiratory tract, given loosely the general name of a cold is, perhaps, the most common ailment with which people, healthy otherwise, have to deal. It is well established that the real cause of colds is bacterial activity. Explorers, while in the arctic regions, where there is no bacterial life, are not afflicted with colds, although they are exposed to greatest extremes of temperature. On their return to civilization, an epidemic of colds usually comes on. A mother with a family of small children does not need to be told that colds are infectious, for if one child catches cold the rest usually have it, although some members of the family, by reason of better resistance, may escape.

Bringing on a Cold

The means by which a cold is usually brought on is through some disturbance of the circulation, most frequently by chilling of the surface of the body. Chilling continued for some time throws a greater volume of blood to the internal organs, and the vessels of the mucous membrane become overcharged. This condition in some way enables the bacteria to gain a foothold and multiply. This, in turn, leads to a further accumulation of blood, especially of the white corpuscles, to repel the invaders. The continued excess of blood results in the inflammation. In this condition some of the capillaries may become stopped up from white corpuscles adhering to the minute

veins, and this makes a congestion. As the bacteria are driven out, the inflammation subsides and the blood vessels are gradually cleared.

Prevention of Colds

The prevention of colds, then, involves keeping the mucous membrane as clear as possible from foreign matters, in accustoming the system to change in external temperature, and in reasonable care that the surface of the body does not become unduly chilled. The first involves the care of the nasal passages and the throat. The most convenient and effective means of doing this is the oil atomizer. A light mineral oil called alboline is generally used. This may be used plain or some medication may be added, such as eucalyptus, menthol, with a very little carbolic acid. A physician will give the proper prescription which should be adapted to the condition of the individual. This oil spray used night and morning, together with gargling the throat with an antiseptic solution, will help to keep the mucous membrane in good condition and to remove the source of infection.

Hardening the System

More important, perhaps, is the training of the heat-regulating mechanism to become less sensitive to change in external temperature — in hardening the system. Cold baths are most effective here. The clothing should not be too warm and the rooms not kept at too high a temperature, for this keeps the skin in continual tropical surroundings, so that any slight change of external temperature has marked effect. Reasonable care should be exercised towards

Catching Cold

chilling the body. The greatest danger comes in sitting still in a room below 65° or remaining inactive for a considerable time in a strong draught or wind. While one is taking active exercise, there is little danger of taking cold. Wet clothing conducts the heat away from the body much more rapidly than when it is dry, so that it is dangerous to remain quiet if the clothing is damp. This is especially true in regard to the shoes and stockings.

Susceptibility to Colds

The body is much more susceptible to colds at one time than at another. Naturally, susceptibility is greater when the other functions of the body are not in good condition. Indigestion may make one especially liable to take cold, and we are always more susceptible when we are tired. If the bedding is too warm, the body may get into a perspiration, and if it is then thrown off unconsciously, a chill is liable to follow before one is awakened.

Care of Colds

"No cold is trivial." Although a slight cold may not occasion serious inconvenience, it should be cared for. Even a slight disturbance of the system by a cold, with the attending inflammation, makes the body less resistant to communicable diseases, and a slight cold may become a serious matter if added to. Frequent colds tend to produce chronic inflammation of the mucous membrane or catarrh which is a condition difficult to cure.

Much may be done when a cold is felt coming on to lessen its effect. Any means which will draw the

blood away from the congested area is helpful. Hot baths, or mustard foot baths are recognized as a means of bringing about the desired results; the taking of hot drinks, as hot lemonade, throws the blood to the skin and away from the mucous membrane.

After the cold has once gained foothold in the body, not very much can be done except to protect the body from further chilling. Cold baths, if taken, should be discontinued; in going out of doors in cold weather the clothing should be warm and come up well around the neck and throat. Very active exercise which produces rapid circulation is not favorable at the height of a cold, but may help to clean out the stopped-up blood vessels at the end of a cold. The taking of drugs, unless the whole system is involved, is worse than useless. Many of the so-called cold cures throw out the digestive system, which needs to be kept in good condition at this time. Local applications, however, may help somewhat. Medicated oil spray will give some relief and "adrenolin" ointment is recommended for a cold in the head. This contains a very small amount of the extract of the adrenal gland of some animal, and has the property of constricting the capillaries locally. If there is a hard cough, which tends to irritate the inflamed area simple cough drops or mixtures, which will prevent the coughing, are useful.

Drugs for Colds

HYGIENE OF CLOTHING

Clothing is worn to help the body maintain an even temperature, also for personal adornment and modesty. Heat is transmitted from the skin by conduction and convection, and leaves the clothing in both these ways, and by radiation.

Conductivity of Cloth

There is only a very slight difference in the conducting power of the substances of which textile fibers themselves are made. The chief difference in the heat-conducting power of fabrics comes from the structural nature of the fiber and the weave. As dry air has less than 1-100 of the conductivity of the fiber substance, clothing is a poor conductor of heat in proportion as it contains air between the meshes and fibers. A number of layers of cloth give more warmth than one of the same weight.

Character of the Textile Fibers

The fibers of wool are very much curled and twisted, and have considerable elasticity or spring, so that they are not easily spun into compact thread or matted. Cotton fiber is flat and twisted, without much elasticity; linen and silk are nearly straight and cylindrical, the fiber of silk being very fine and that of linen much coarser than any of the other textile fibers. Wool fabrics, because of the character of the fiber and the way in which it is woven, enclose the greatest amount of air between the fibers, and so make the warmest clothing. Cotton may be so woven as to be almost equal to wool in this respect,

but it mats much more readily. If meshes are *too* large, the heat is carried away rapidly by convection — especially by moving air.

Relation of Clothing to Perspiration

Although clothing should prevent undue loss of heat, it should not prevent the escape of perspiration. It is only by evaporating that the perspiration carries away heat. If the vapor cannot escape, the skin is apt to become too warm, more perspiration is given off, and the underclothing becomes saturated; water replaces the air and the underclothing then becomes a very good conductor of heat. If there is any movement of the air, the heat is taken away rapidly, both by convection and increased evaporation, so the body may become chilled. A leather jacket or newspaper worn under the coat may be desirable out of doors to keep cold winds from penetrating the clothing, but any covering which prevents the evaporation of the perspiration as fast as it is formed, is very undesirable. Rubber waterproof garments are for this reason very uncomfortable during warm weather. Fabric called "cravenette," which is treated so as to be waterproof, yet still retain its porous character, is more desirable.

Warm Weather Clothing

Clothing for the hot days in summer should impede the escape of superfluous heat and the perspiration as little as possible. For underclothing the open mesh or net knit goods seems most suitable. While this permits the free circulation of air, and so ready cooling, it makes an extra layer of air between the

skin and outer clothing when additional wraps are added, and so gives considerable warmth.

Winter Clothing

The amount of clothing to be worn in winter depends upon conditions. People living in a city in houses more apt to be overheated than underheated, and riding in heated street cars, require clothing but little heavier in winter than in spring or fall. Increased warmth when going out of doors is better obtained by putting on extra warm outside wraps, which are removed when in the house. For robust people, only medium weight clothing, especially underclothing, ought to be worn, for when the temperature of the rooms is kept at 68 degrees F., with heavy underclothing perspiration becomes active, and the skin is made very sensitive to the changes in temperature and the liability of taking cold increased. Old people leading inactive lives and those who are not strong may require thicker underclothing.

Those who live in the country where houses may not be well or uniformly heated, or people who are much out of doors and *inactive*, as when riding in carriages, may well protect themselves by thicker underclothing, as well as with warm outside garments.

Effect of Color of Clothing

Color has some effect on the *radiation* and *reflection* of heat by clothing. White reflects heat, as it does light, much more completely than black or dark colors which absorb it, so we wear white in the hot sunshine of the summer. Dark colors which absorb heat *radiate* it better than white or light colors. For

this reason, white is warmer in winter, except in the sunshine, as well as cooler in summer. It is stated that a white rabbit loses only three-fourths as much heat as one whose coat is gray or black. White or light colored underclothing and bedding, then, is somewhat warmer than that of dark color.

Uniform Warmth

Clothing should be of uniform thickness all over the body, as there seems to be no logical reason why one part of the body needs greater protection than another in health — although it may be desirable to protect certain parts in special cases. Clothing should allow unrestricted movement of all parts of the body.

Freedom from Restriction

Constriction at any place disturbs the circulation of the blood and interferes with proper nutrition. Circular garters for holding up the stockings have no excuse for being. Nothing will so quickly ruin the graceful curves of the neck as a tight collar.

The Corset

It would be impossible to write of the hygiene of clothing without adding a word to the already sufficiently great protest against the corset. *If* the corset is not worn until full growth is attained, and *if* it is the proper shape and not too stiff, and *if* it is not worn too tight (but no woman will admit that she wears her corset *tight*), then they do little or no harm. It is hardly less than criminal to put a young growing girl into a tight waist or corset. The abdominal organs need the support of the abdominal muscles to keep them in a proper position and the muscles can only be developed by use. Natural breathing

is prevented, the natural figure is distorted by the constriction, grace of movement is interfered with because of the cramping and under-development of the muscles of the waist.

Boys might be put into corsets and men wear them with comparatively little harm. The corset and the high heeled shoe are, according to all physicians, responsible for the greater part of the ills peculiar to women. Undoubtedly to the corset may be attributed more suffering in America yearly than was ever caused by the Spanish Inquisition.

Deformed Waists

A waist too small is as much of a deformity as too small a neck. Compare a fashion plate to a Greek statue! In time education may lead to reform, but there seems to be no hope at present that the corset will be banished, at least for dress-up occasions.

Working Dresses

However, there seems to be no good reason why a woman's clothing, while working about the house, should not be so constructed as to make a corset unnecessary. As made at present, skirts which fasten with a draw-string or narrow band at the waist are uncomfortable without a corset, but they may be made with a wide fitted band so as to be supported by the hips and waist, or made on a waist and supported by the shoulders. Union suits and combination garments are a step in the right direction. Equestrain tights are warmer and not so heavy as thick underskirts.

SHOES

Foot Troubles

Because the feet have such heavy duty to perform and are so important in connection with physical exercise, shoes deserve considerable attention from the hygienic standpoint. American shoes are now constructed more in accordance with the natural shape of the foot than formerly, but it is rather rare that the adult foot is not mis-shapen by wearing improper shoes, and corns, bunions, ingrowing nails are still very common.

Preserving the Arch of the Instep

The foot is made up of twenty-six small bones, which are held in place by ligaments, cords and muscles. To preserve the arch of the instep, all of these must be strong and well developed. The important cords running under the instep to the toes form the bow-string action necessary to maintain the truss which the arch of the instep really is. They may be easily felt by placing a hand under the instep. To make these tendons strong, the toes must have full play, and this they cannot have in the typical pointed shoe. In order to act as a perfect lever, the great toe should be nearly straight in the line of the foot and hence the inside line of the shoes should be nearly straight. The toes should be sufficiently wide; the soles should be flexible, so that the toes may be able to push in walking. A large stiff box prevents this. Now-a-days it is possible to obtain ready-made shoes that fulfill these requirements which are still not clumsy in appearance. The shoe

should fit snugly around the instep and heel, but allow sufficient room at the ball of the foot and toes.

Flat Foot

People who have worn shoes that have deformed the feet and have prevented the development of strong cords and tendons, are apt to have the arch give way some time during middle life. The bones of the instep sag, giving the condition called "flat foot." This, in addition to being very painful, prevents enjoyment of the very good and most available form of physical exercise — walking.

Those afflicted with flat foot find some relief in using a metal innersole made for the condition, or in especially constructed shoes, which support the instep.

Corns and Bunions

Corns are a malignant growth of a papilla caused by irritation of an ill-fitting shoe, usually by shoes that are too small — sometimes by too large a shoe. They may be cured by the attention of a chiropodist, the wearing of shoes which prevent the irritation, and thorough cleanliness. A bunion is a much more serious affair, being a disease of the joint of the great toe, and caused from a turning out of the toe by pointed shoes, and by pressure. Since the improvement of the art of shoe-making, they are much less common than formerly.

Perspiring Feet

While leather is somewhat porous, it is not sufficiently so in many cases to permit the perspiration to escape as fast as it is formed. This leads to an accumulation of perspiration, the stockings become damp and then the feet grow cold easily. If

the sweat glands of the feet are especially active, shoes of thin leather should be worn and thin stockings. If the feet are especially tender, a nightly bathing in warm water and then in cold, with the application of a little oil, will prove beneficial.

Low Shoes Low shoes, because they give good ventilation, are a hygienic form of footwear, especially for the summer months. If gaiters are put on when out of doors they may be worn the year round. Tan shoes reflect heat, and so are cooler for summer wear. Patent leather shoes are practically non-porous because of the coating of varnish, and are not suitable for constant wear.

Rubbers Rubbers seem to be a necessary evil, and undoubtedly prevent many colds. The sandal variety which protects the soles sufficiently do not cause the feet to perspire so much as those that cover the entire foot. A liberal application of oil to the soles of shoes makes them much more water-proof. It is said that the vegetable and animal oils, such as salad oil and lard oil, are better for the leather than mineral oils.

PHYSICAL EXERCISE

The hygiene of physical exercise has been left until now because it is so inclusive. We all know of people who take little muscular exercise, yet seem to maintain a fair degree of health. Is muscular exercise absolutely necessary for health, and if so, why? We must remember that those who seem to get along comfortably with hardly any physical activity, are the exceptions. Many, very many more leading inactive lives are continually in a half-well condition. The mere act of sitting, standing and walking involves some muscular activity, and undoubtedly is the physical salvation of many who lead sedentary lives.

Necessity of Muscular Activity

As to why muscular activity is so essential to health, it is only necessary to point out that about half the weight of the adult body is made up of the skeletal muscles (those attached to bones). Further, the fat of the body is so much lifeless food material, the bones, except the outer layer, are practically lifeless, the connecting tissues, cords and tendons have comparatively few living cells, and the blood, aside from the corpuscles, consists of nutrients, wastes and water. There remain the glands, nerve tissue, and muscles, which constitute the active, *living* cells of the body. Of these the muscles comprise over three-fourths by weight. The really living part of the body, then, is made up largely of the muscles. They are the dominant tissues; for them the organs

of digestion, respiration, circulation, and elimination do most of their work.

Developed Through Muscular Activity

In the child, muscular activity trains and develops the nervous system, the heat regulating mechanism, the heart, the lungs, the digestive organs, and the muscles themselves. The development of the bones, even, is largely dependent on muscular exercise. It is easy to see, then, why nature has made the life of the young one of constant muscular activity.

As no organ except, perhaps, a part of the brain, can be properly developed without muscular activity, so the full strength and activity of no organ or function can be *maintained* except through muscular exercise.

Reserve Power

An automobile with a half-horse power engine is able to run along without trouble so long as the road is smooth and level. Rough going, or a hill, however, would cause something to break or bring the engine to a dead stop. Reserve power is needed. In the same way we all need reserve power to weather the storms and overcome the rough places in life. We need to be able to "speed up" for a time, if necessary.

Effects of Physical Culture

The good effects given by physical activity are (1) the *training of the heart* — muscular exercise is the only natural way of increasing the number and power of the heart-beats, and so in maintaining a strong heart. (2) *Respiration* is increased and deepened during muscular activity, the capacity of

the chest increased by movement of the ribs, the lungs ventilated, and all of the remote air sacs distended. (3) The *circulation* is made more rapid by exercise and rhythmic contraction and relaxing of the muscles, combined with deep breathing, are powerful aids to a good circulation, preventing stagnation in the blood vessels, and especially in the lymph vessels. This leads to better *elimination*. (4) The *heat regulating mechanism* is trained, for muscular exercise sets free much heat. (5) Moderate exercise has a favorable effect on *digestion*, and the movements of the abdominal muscles help *peristalsis;* exercise gives a keen *appetite*, and so helps digestion. (6) General exercise gives the body general fatigue and thus makes *sleep* natural and profound.

Human Machine Built for Work

The life of our ancestors involved considerable muscular activity, and the human machine is adapted to do a large amount of muscular work. Conditions of living have changed faster than the physical body could possibly change. We have essentially the same sort of a body as that of our prehistoric ancestors. It is a question whether the race will ever develop into one with weak muscles, small bones, and degenerate organs. Certainly the type of man would not be so high.

Two generations or so ago few people were troubled because of lack of physical activity. Nearly all received a sufficient amount in the course of their daily living. It is estimated that the amount of mus-

cular work performed by the people of the United States has decreased about 75 per cent during the last twenty-five years. This great change is due to the introduction of all sorts of labor-saving machines. A generation ago wage earners did a great deal of laborious muscular work; now they accomplish more by sitting down and tending a machine which does the mechanical part and simply requires close watching. A corresponding change, although to a less extent, has taken place in housework. Running water, coal and gas stoves, sewerage have lessened greatly the amount of laborious work necessary.

Increase of Nervous Activity

There are certainly many advantages in this decreased amount of muscular work needed at present, but there are also disadvantages. With the decrease in manual labor, there has been an accompanying great increase in the nervous energy required in the life of to-day. Investigations have revealed the fact that city families on an average do not last more than three generations, and rarely more than two, without the addition of country stock. It is undeniably true that average conditions of life in a city are not so favorable to health as the conditions which exist in the country. This comes about through less muscular activity, less out-door life and more mental work, excitement and nervous stimulation. There is no principle in hygiene better established than that considerable muscular activity is necessary to counteract the evil effects of sedentary life.

Economy of Time

The objection is often made that "there is no time," but time *must be found.* The necessary physical activity takes no more time than that lost through illness. The diminished efficiency in work counts for more than time actually spent in muscular activity needed for health, to say nothing of the increased pleasure of living and joy that comes with abundant vitality. The amount of neglect and abuse that the human machine will stand is surprising, but physical sins have their punishment soon or late.

Physical self-sacrifice which may perhaps lead to invalidism or death is never justifiable. It is better for the children to receive less of the mother's time and still have a mother; better for the family to have less money than no provider.

Principles of Hyiegnic Exercises

There are certain essential principles governing the value of various forms of muscular activity. Exercise taken for its hygienic effect should involve a maximum amount of muscular work and a mininum of nervous energy. This is accomplished by exercising the large group muscles of the legs and trunk rather than the small muscles of the arm. A considerable amount of muscular work is done in playing the piano, but the amount of nervous energy expended is so great that the activity does not serve the purpose of hygienic exercise. Brisk walking, swimming, bicycle riding, golf, and the like, call for a considerable amount of work by the larger muscles, and for this reason are valuable hygienic exercises. The exercise

should be sufficiently vigorous to increase the activity of the *heart* and *lungs*. It should be rhythmic rather than sustained, because such exercises are more pleasurable and less apt to cause strain. It should be enjoyable, if possible, and so rest the mind.

Undoubtedly the best kind of physical exercise is that involved unconsciously in one's daily occupation. A long walk taken to one's place of business or to do marketing is better than the same amount of walking done simply for the exercise. A situation "only a two minutes walk" from the markets, station, or street car is not always desirable for one's homes.

A mother with three or four small children, doing most of the housework, gets sufficient physical activity, perhaps more than enough. What she needs is a lessening of nervous strain through social relaxation and moderate out-door activity.

Housework as Exercise

If the clothing be loose, the shoulders kept back, the chin in, housework is a very good form of physical exercise (except that it is indoors), but if the work is not well organized, or if there is a wrong attitude of mind towards the work, the nervous strain and mental disquietude counteract the good physical effects. But there are many women able to keep two or three servants, whose physical (and mental) health would be far better if they were not so fortunate (?) and found it necessary to do more of the housework.

For those leading a sedentary life, then, some muscular activity outside the daily routine is necessary

for health. No argument is necessary to prove that when possible exercise should be taken in the open air. The simplest, most universally available and a very desirable out-of-door exercise, is walking. It is estimated that a brisk walk of two or three miles a day, or its equivalent, is needed on the average to keep a man or woman in good physical condition. The walk must be rapid—between three and four miles an hour. The saunter of the typical "constitutional" requires little more muscular activity than standing. Walking on level city pavements produces weariness long before an adequate amount of muscular exercise has been done. The feeling of monotony and weariness does not come so soon if the walk is taken in good company. A cross-country walk up and down hill is usually delightful and most beneficial exercise.

Walking

It is always better to walk with some object in view. Any physical exercise, taken simply for the exercise, although it may have some favorable effect, cannot begin to compare with that through which pleasure is obtained. Out-of-door *fads* involving considerable walking contribute greatly to physical well-being. Among such are botanizing, the study of birds, of butterflies, and all of the many forms of nature study, microscopy, geology, amateur photography, and the like. For the summer vacation there is mountain climbing. There is no way equal to walking of coming close to nature and getting at her wonderful secrets. Often exploration of one's own

Out-of-Door Recreation

city or town will yield much of interest in history and sociology. We are apt to neglect the things within walking distance.

Bicycling

Bicycling has some advantages over walking, as it involves a greater distribution of muscular effort and so a greater total amount of work may be done without fatigue. It gives one a much larger radius and a wider range of interests. It is a pity that bicycling has now lost the vogue it formerly held, but it is just as enjoyable as ever, and machines are much less expensive. Automobiling and carriage riding give very little exercise. Taking the air is desirable, but not a substitute for physical activity. The rapid motion and fresh air may whet the appetite, and so tempt one to over-eat.

Horseback Riding

Horseback riding is an excellent form of exercise, although not suitable for delicate women. It is expensive in the city, but not so in the country.

Rowing

Rowing and paddling are exceedingly valuable. They are easily learned, pleasurable, and are usually associated with beautiful scenery and delightful surroundings. The movements involved in handling the oars and paddles are particularly adapted to the exercise and strengthening of the arms, back, chest and waist.

Swimming

Swimming is a most fascinating and exhilarating exercise, especially when practiced in the ocean. It involves the activity of nearly all the muscles in the body, and tends to give a symmetrical figure and

erect carriage. Because swimming is so enjoyable there is danger of remaining too long in the water, if the water is cold. If the body becomes chilled and the lips blue, much more harm than good comes from sea bathing. Swimming has the disadvantage of being difficult to learn after youth.

Golf

Of the out-of-door sports, golf seems to be the most generally valuable. It is not difficult for adults to acquire some proficiency, it is suitable for all ages; nearly all get the "enthusiasm;" it can be played nearly all the year round. In addition to the muscles involved in walking, there is moderate exercise for the arms, shoulders, back, waist and abdominal muscles. It occupies the mind completely, and most people find they can cover a distance in following the ball that would be impossible in a straight-away walk. Much or little exercise can be taken, as desired.

Tennis

Lawn tennis, also, has many advantages. It is interesting, adapts itself to mild, moderate, or vigorous exercise, and the movement involved in lifting the arms overhead, the frequent bendings and twistings of the waist, the running and jumping, make it a splendid all-around exercise. The disadvantages are that the game is difficult to learn after youth, and like golf it is not available for every one.

Croquet, archery, and the like, are mild forms of exercise, and although better than nothing, do not give robust people sufficient muscular activity for the time taken.

Winter Sports

It is more difficult to get sufficient out-of-door exercise in winter. Skating, snowshoeing, tobogganing are excellent, but they are usually possible only at irregular intervals and cannot be depended upon for regular exercise. Walking is always available, but somewhat less interesting. In winter we must resort to indoor games which afford valuable exercise, combined with recreation. Bowling is easily learned, and combines activity, with considerable enjoyment. Even though only one hand is used, there is little danger of one-sided development in bowling two or three times a week.

Gymnasium Games

Fencing has many advantages as an indoor exercise. It gives grace of movement, an erect carriage, agility and precision. The combative element makes fencing fascinating, and develops judgment, coolness and self-control. Basket ball is an excellent indoor game, but it is apt to become somewhat violent. Hand ball is a very good gymnasium game.

Dancing

Were it not for poor ventilation and late hours, dancing would be an admirable form of exercise, but in a close, dusty hall it is of doubtlul value. However, it is possible to have good ventilation and to stop at a reasonable hour.

Gymnastics

In addition to the indoor games there is an endless variety of systematic gymnastic movements which, if practiced regularly and judiciously under a trained instructor, bring about the very best results in the correction of faulty carriage and in de-

FUNDAMENTAL POSITION

veloping the muscles, as well as in the maintaining of good physical condition. We are not concerned here with the large subject of physical education, but are more interested in gymnastics from the hygienic standpoint. While the best results are obtained in gymnasium classes under a trained instructor, it is possible to receive much good by practicing free movements, without apparatus, at home. For this purpose a few selected typical movements are described and illustrated here for the benefit of those who are willing to give ten or fifteen minutes every day to maintaining and improving their physical condition.*

Home Exercise

There are two series of exercises. Those in the first series are simple and not very vigorous; those in the second series—in brackets—are more vigorous, and should not be tried until those in the first series have been practiced for several weeks. All the exercises in the two series may be taken by vigorous women after a few weeks' practice.

The figures indicate the counts that correspond to the movements in each exercise. It is well to count while doing the movements.

Try to imitate the positions in the illustrations as accurately as possible. Practice each exercise about 8 counts at first and increase gradually to 32

*Exercises designed and photographs furnished by Professor G. L. Meylan, Director Gymnasium Department, Columbia University.

EXERCISE 1.

One. – Bend head backward.
Two. – Return to position.

EXERCISE 2.

One — Bend arms. Raise heels.
Two.— Return to position.

counts in five or six weeks. The rhythm should be rather slow at first, and increased gradually up to moderate rapidity. The total amount of work is increased by doing the exercises rapidly.

Avoid doing the exercises in a jerky manner. It is well to stand before a mirror while learning them, to make sure that all the positions are taken accurately.

Dress and Ventilation

Have the windows wide open, dress loosely; take three or four deep breaths and begin the exercises, being careful to take them in the order given. The breathing should be deep and regular while doing the movements. Follow the exercise by a cool sponge bath and a vigorous rub with a coarse towel.

EXERCISE 1

One—Bend head backward, with chin in, hands on hips, and shoulders low (inhale as head goes back).
Two—Return to position.

EXERCISE 2

One—Arm bending and heel raising.
Two—Return to position.
One—Raise heels.
Two—Lower heels and raise toes (rest hands on back of chair if necessary to maintain balance).

EXERCISE 3.

One.—Raise arms sideways and bend the knees.

EXERCISE 3

One—Raise arms sideways and bend knees.

Two—Return to position.

One—Raise arms sideways (and bend knees as far down as possible).

Two—Return to position.

EXERCISE 4

One—With hands on hips and feet apart, bend sideways to right.

Two—Straighten up.

Three—Bend sideways to left.

Four—Straighten up.

(Same as preceding exercise, only with hands back of neck.)

EXERCISE 5

One—With arms bent and feet apart, bend forward with back straight.

Two—Stretch arms overhead.

Three—Bend the arms.

Fourth—Straighten up.

EXERCISE 6

One—Lift right knee high.

Two—Replace right leg on floor and lift left knee immediately (stationary walking in moderately quick rhythm).

One—(Same as previous exercise, only with knees straight, supporting the hands on back of chair if necessary.)

EXERCISE 4.

One.— Bend sideways, hands on the hips.

EXERCISE 5.

Two.—Stretch arms over head after bending.

EXERCISE 6.

One.—Lift knee high.

EXERCISE 7

One—Bend arms.
Two—Stretch arms overhead as high as possible.
Three—Bend the arms.
Four—Stretch the arms horizontally sideways.
Five—Bend the arms.
Six—Stretch the arms down to sides.

EXERCISE 8

One—With hands on neck, twist to right (try not to move below the waist).
Two—Return to position.
Three—Twist to left.
Four—Return to position.

EXERCISE 9

(*a*). *One*—With arms bent and feet apart, bend down and try to touch the floor (knees straight).
Two—Straighten up.
Three—Stretch arms overhead.
Four—Bend the arms.
(*b*). *One*—From fundamental position, bend the arms.
Two—Jump to position feet apart, and at the same time bend down and try to touch the floor.
Three—Straighten up, with arms overhead.
Four—Jump to position.

EXERCISE 7.

Two.— Stretch arms over head.

EXERCISE 8.

One.— Twist to the right.

EXERCISE 10

(*a*) Place hands on a chair.

One—Reach back with right foot as far as possible.

Two—Place left foot beside right foot and maintain body straight.

Three—Return right foot.

Four—Return left foot.

(Same as preceding exercise only move both feet back at the same time.)

(*b*) Lie on the floor with hands back of neck.

One—Raise right leg as high as possible with knee straight.

Two—Lower right leg to floor.

Three—Raise left leg.

Four—Lower left leg.

EXERCISE 11

With hands on hips and heels raised, jump up and down with feet together.

(Same as preceding exercise, only jump with feet apart and together alternately.)

EXERCISE 12

Run in place, lifting the heels high up behind.

(Same as preceding exercise, only lift knees high in front at each step.)

EXERCISE 10.

Two.— Place left foot beside the right, keeping the body straight.

EXERCISE 14.

One.—Raise arms sideways, palms down.

EXERCISE 14.

One continued.—Turn hands over, bend head back, take deep breath

EXERCISE 13

One—Raise the arms forward—upward as high as possible while taking a deep breath.

Two—Bring arms down sideways while breathing, breathe out.

EXERCISE 14

One—Raise arms sideways to horizontal, palms down, turn hands over with backward bending of head and taking a deep breath.

Two—lower the arms, return head to position and out.

Exercise Not All

Although the practice of the foregoing or other home gymnastics will bring about a great improvement in health, attention must, of course, be given to correct carriage of the body, standing or sitting, proper method of breathing, wholesome food, and so on. *Fifteen minutes gymnastic work will not counteract the effect of the infringement of all other rules of hygiene through the rest of the twenty-four hours.*

Monotony

The great drawback to home gymnastics is that the work grows monotonous after a week or two, and some strength of mind is required to keep up the daily practice. However, the exercises may be varied, often by out-of-doors exercise, or light apparatus may be used. From the hygienic standpoint it does not matter much how the physical activity is obtained so long as it *is* obtained daily. Even if it does become monotonous at times, the results justify

the effort. Care of the body in general is not particularly interesting, but habit makes it a matter of course. Practicing scales on the piano is irksome, but it is the only means to a desired end; so *physical activity is the only means of acquiring and maintaining a high degree of personal health.*

PERSONAL HYGIENE

Part III

Read Carefully. A number of personal questions are asked in connection with this lesson, not for the information of the instructor, but to bring the matter home to you, and to enable you to clarify your thoughts by writing them out. Answer fully and leave space between answers.

1. Give a brief account of your own health history with the probable reason for any periods of lack of health.
2. (a) Why is the care of the nervous system so important? (b) How are strong nerves developed, and how maintained? (c) Why is sleep necessary? How much do you find that you need?
3. Why is it important that good personal habits and habits of work be formed early? (b) What is laziness?
4. What are the important points in the care of the teeth? How should your own teeth be cared for?
5. (a) What determines the amount of food required? (b) Which do you consider the most important (1) the chemical composition of food, (2) the manner of eating, or (3) the way the food is cooked and why? (c) What are your own food problems?

6. Why is it desirable to drink a considerable amount of water? About what quantity of water or other liquids do you take daily?
7. What factors determine the effects of baths? Do you find a daily cool bath of any kind beneficial?
8. Give the principles governing (a) health of the hair, (b) health of the complexion.
9. What are "colds?" How are they brought on, and how prevented? How should a cold be cared for?
10. What can you say of the hygiene of clothing? (b) To what extent does the question of health govern the selection of your own clothing?
11. Why is the care of the feet and the selection of shoes of importance?
12. What reasons are there for believing that a certain amount of physical activity is necessary for health? Answer fully.
13. Give the principles governing the good hygienic effects of exercise.
14. What forms of physical activity are available for you at the present time?
15. In the care of your own health what tendency or weakness calls for special attention? What can you do to overcome such fault?

16. Make out an hourly schedule for yourself, giving hours for work, recreation, eating, and sleep, and allowing some time for the care of health — a schedule which you could easily follow, say for 350 days in the year.
17. Give your opinion of the duty of health.
18. What is your feeling in regard to the taking of medicine (meaning drugs) for minor ailments and without a physician's orders?
19. Which would you say was greater, the influence of health of mind on health of the body, or the influence of the health of body on health of mind?
20. Draw up a set of good resolutions relating to your personal health. (A certain place is said to be paved with good intentions, but "heaven is vaulted with them.")
21. Have you read any of the books recommended or others in connection with this lesson?
22. What questions have you?

Note.—After completing the answers, sign your full name.

ETHICS OF HEALTH; OR HEALTH A DUTY

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UNITY OF THE BODY, MIND, AND SOUL

The attempt to classify man under the headings of the physical, mental, and moral is misleading. No clear distinction exists or can be made between these three conditions or attributes. The complete unity of man is one of the most striking and significant facts in nature. The interdependence between different organs, functions, and faculties is so close and vital that what affects a part of the organism affects all of it, and the indirect influences frequently are so subtle and far-reaching as to confuse the best of physicians, physiologists, and psychologists.

The nervous system is as genuinely physical as bones and muscle. The brain is a physical structure — a part of the nervous system — and mind is a function of the brain; so that mental activity is essentially as physical a process as digestion, muscular action, or the circulation of the blood. Mental activity is hidden away within the brain in the skull, but the only way in which *mental action* can be expressed to others is through *muscular action* in speech, or writing, or the expression of the face, or the rest of the body.

Moral qualities have to be expressed in a similar way. In fact, "moral" refers to the attitude of the person in relation to others in purpose and conduct. Moreover, the moral tone and quality of the individual depends vitally upon physical structure, functional health, and bodily vigor.

The person who has dyspepsia or other physiologic disorders is apt to be depressed mentally; lacking in energy to do things, and frequently morbid in conscience. The vicious, criminally minded, and immoral have often been found to be deformed or diseased, and incapable, therefore, of meeting human responsibilities. "Weakness is often akin to wickedness."

In many cases no clear distinction can be made between weakness of body, mind, or soul. Some real and other apparent exceptions to this statement do not disprove the fact, or lessen the importance of the general principle. The importance of the so-called physical, then, is to be estimated in its relation to the highest and best faculties of the human being which depend upon and express themselves through the human organism.

INHERITED CHARACTERISTICS

More extraordinary than the unity of the individual human being is the continuity of human life. Heredity is a vague and comprehensive term referring to all the influences affecting the child up to the time he is

born, coming from parents, grandparents, and all the ancestors back to the beginning of living things, from which the child is descended. The number of bones and organs; the shape of the body; the relation of its parts; similarity in color of hair; expression of face; even in gesture and gait, are all inherited in various degrees by child from parent.

More subtle characteristics in temperament, mental and moral qualities seem to be handed down in families. Individual deformities due to accident or injury are not inherited, and many of the popular beliefs regarding prenatal influences are without foundation in fact.

TENDENCY IN HEREDITY

Different from the inherited characteristics already briefly alluded to are the organic influences transmitted directly from parent to child, and of much hygienic importance. Children are rarely stronger and healthier than their parents, unless special attention is given to physical education. Much more frequently where there is a real difference, the children are less robust and more inclined to disease. Tendencies to degeneration and disease are much more apt to be transmitted than the tendency to improvement of any kind.

The diseases due to immorality and vicious living are most apt to be transmitted to children. Tendencies to gout, rheumatism, some diseases of the heart and other vital organs, and the various nervous dis-

orders are not infrequently transmitted from parent to child. Tuberculosis — either of the lungs or of other parts of the body — is almost never transmitted directly, but the tendency or susceptibility to tuberculosis — transmitted to the child by the tuberculous parent — is one of the most definite and serious facts in human life.

The fundamental and inalienable birthright of the child is that he shall be born of parents and earlier ancestors who have lived their lives with an intelligent and conscientious sense of their responsibility to their possible descendants.

RIGHT LIVING

The science of healthy living is to-day well understood by a few (physicians and others), but in general and in relation to its intrinsic importance, hygiene rceives less attention than any other subject.

More serious yet is the fact that in the care of health, conduct falls so far short of the knowledge which people have upon this subject. Nowhere in the realm of human affairs is there a greater gap between theory and practice, between knowledge and action, than in the matter of hygiene. It is claimed, and probably is true, that human life is on the average longer to-day than it was a few generations ago. Nevertheless, the human animal is the least sound organically of all the species of living things — i. e., less free from disease, and further from the best

health and power possible if adequate attention and care were given to health.

INSTINCT VERSUS INTELLIGENCE

In nature, under the guidance of instinct, the wild animals live healthy lives and transmit to their young the capacity for the highest degree of strength and health. They strive for the best conditions of life possible to them, and in so doing work unconsciously for the best health of their offspring and the race to which they belong. Thus does nature insure a fine quality of life among her creatures. The first effort of the animal is for self-preservation, although at times life is sacrificed for the sake of the young. The weak and injured are left to perish, and there are lacking in the animal world many of the finer and nobler human attributes, but a high standard of health in the species is maintained.

Human beings are not guided so surely by instinct as are the animals, nor are they usually as healthy and strong as the creatures in nature. This is due to the fact that intelligence, reason, and conscience do not impel civilized men and women to lead as healthy, wholesome lives as the animals live under the guidance of instinct in nature. Human beings are not yet wise enough to realize in practice the true value of the highest physical efficiency and their responsibility for it

DUTY TO POSTERITY

Each human being has received from his ancestors life and a certain capacity for health and strength. The people of this generation must be the parents of the next, and thus each generation is the connecting link between all the life of the past and all the life of the future. This responsibility imposed by nature of receiving life from the past and handing it on to the future is a racial obligation; is fundamental and must receive much more intelligent and rational human care than has yet been given to it.

The duty to be well and strong, to maintain the best possible standard of organic soundness, to improve one's human power and efficiency to the highest possible pitch, is owed to one's self, to one's ancestors, to one's contemporaries, and vastly more to one's children, and to the children's children in coming generations. Human life and health are not simply individual possessions to be controlled solely or primarily for immediate ends; to be sacrificed for personal caprice or even ambition. They may not contribute *alone* to individual achievements, however worthy such may be or seem. They may in justice be used for the present only so far as such immediate use does not detract from but rather enhances their value for the future offspring whose chance for life and health depends upon their present treatment and care. A clear understanding of this great continuity of life and

its implications will modify human thought and conduct in manifold ways.

CIVILIZATION AND HEALTH

Human demands and interests to-day are much more numerous and confused than those of the animals, or even those of primitive man. Civilization rapidly increases the complexity of the human environment and multiplies to confusion the demands upon time and strength. Many of these lead away from, and not a few are in direct opposition, to the laws of rational and wholesome living.

Instinct guides the animal wisely in a multitude of ways, while man too often ignorantly or heedlessly stumbles through life, using haphazard, and perhaps destructively, the precious heritage of the ages.

SELFISHNESS

Human selfishness causes much of the irrational and unhygienic living and often prevents obedience to the laws of health which are well known. The objects for which people struggle are often superficial in value, and if attained are frequently purchased at the expense of health and perhaps of other values even more important than health in our human world. Money beyond what is needed; fashionable houses; furniture and clothing beyond that which is required for the highest living; fame in the commerical, political, social, or scholastic world beyond what is rational;

all these and other motives impel many beyond what is their reasonable best at the expense of other and more important values. But worse than the penalties involved for the adult person through unwise action are the injuries done to the health and the future of children through the folly and ignorance of parents.

It seems of slight moment comparatively to sacrifice some sleep, some rest, some healthful exercises when human affairs crowd; or to eat more than is needed, or a dish less wholesome, that the taste may be gratified. These errors are usually less serious for the grown person than for the child, but they are all wrong in principle, and they are often due to some degree of selfishness.

PROTECTION OF HEALTH PARAMOUNT

Health is not the highest or finest value in human life, nor is it the chief end of living, but health is absolutely essential to the best success in the life and work of the individual, and it is even more important for the welfare of human society and of the race. The child's health should be sacrificed to nothing else by the parent, the teacher, or the community; and in adult life health should be given for other things only very rarely. This protection of health should not be given in any selfish way, nor should it conflict in child or adult with the expression of human courage, self-sacrifice, and devotion to the needs of others.

The risking of health or life even, in the effort to help or save a fellow being in emergency, must always be considered higher and finer conduct than mere self-preservation or care. However, this unselfish devotion of life and strength to others is not a real exception to the rule of health preservation, but emphasizes the importance of considering health care a *duty*, in order that one may be most efficiently prepared for life emergencies.

In relative value the life and health of the child is more important than that of the parent because he has more of his life ahead with its undeveloped possibilities, and the child of to-day will be the parent of the children of the next generation.

This great racial obligation, if recognized, must give each individual a stronger reason and an inspiring motive for the best care of health which human science may show to him.

"NO MAN LIVETH TO HIMSELF ALONE"

The short-sighted and spasmodic attention given to health, ordinarily, leads people to guard their physical welfare as if it belonged solely to them; as if no one else, at least beyond their immediate family and children, had any claim upon it. Parents usually foster their children's health as if the world were to end with the child. This well intended but often misdirected attention frequently makes the child selfish and too self-conscious. This protection of

health for one's self and for the children under one's care — whether as parent or teacher — should constantly aim to make the individual more capable and effective in doing for others. In this way, the care of health, instead of being a self-centred process, may become an impelling factor in higher and better living.

IDEALS IN LIVING

To maintain the highest standard of health possible to each individual involves an unselfish, intelligent devotion to high ideals of living and a sacrifice of present indulgences to future well-being. Instinct, feeling, and appetite are useful indications, but they must be controlled and guided by reason and judgment. The individual who eats at regular intervals, in suitable amounts, the portions of food intelligently adapted to his needs will in the long run, and frequently from the beginning, have better health and get more pleasure from eating than the person who consumes without judgment what he happens to crave. The person who takes muscular exercise rationally will enjoy movement, while the individual who neglects wholesome activity soon loses the pleasure of exercise. Thus does nature reward those who obey, and punish those who violate, the laws of life and health

Human appetites and desires bring genuine satisfaction only to those who control instinct and passion for the welfare of the family, of society, and the race.

Happiness here, as in other phases of life, cannot be attained simply by pursuing it for its own sake. True happiness is simply the pleasure and satisfaction accompanying wise conduct.

Consistent living will bridge the gap between the knowledge and practice of hygiene, but it is important to remember that people will not live consistently simply through the knowledge of the laws of health. Too many other goals in life appeal to the mind and ambition of the individual.

A rational consistent care of health is a fundamental and most important duty for each one, and the human conscience must be aroused to the importance of this duty. *The duty to health must become a part of one's religion.* The conscience must be touched, the heart thrilled, and the imagination fired with a compelling devotion to this ideal of living which will hold the individual to a care of health, which will be in accord with the more immediate and the large relations and responsibilities.

THE USE AND ABUSE OF DRUGS

By H. M. Lufkin, M. D.

Professor of Physical Diagnosis and Clinical Medicine, University of Minnesota

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The teaching of medicine in the earliest periods of recorded history was associated with the offices of religious worship. The little known of medicine, confined to the priestcraft, was jealously guarded and its administration surrounded by the mystic rights and superstitious practices common to an age when the operation of natural laws was ascribed to the occult. The dawn of the Christian era witnessed a gradual decline of the priestly influence in medicine and independent philosophers and scholars, or "savants," made their names famous by their medical teaching. Through the intervening centuries progress in medicine has kept pace with the other sciences. Schools and dogmas have risen, attained more or less fame; have contributed perhaps something or nothing to the sum total of accepted fact, and sinking again into oblivion, have been followed by other schools and dogmas.

Until the advance of the related sciences made research productive, medicine remained more an art than a science. Chemistry, physics, botany, experimental physiology, and biology are the handmaidens of a broad and enlightened profession. Growing out

of the general advance, and as a result of the accumulated knowledge, one great and illuminating fact stands out at the present time, and that is, that the *prevention* of disease is easier to effect than its cure.

"Health is that condition of the system in which all the organs of the body and mind act in harmony and without sensible disturbance." It is a truism that, "In the health of the people lies the strength of the nation."

The public health is the sum total of that of all its individuals. Hence, the individual has the responsibility of considering himself as an independent unit and as a part of the body politic. Aside from the personal discomfort of ill health he must consider his influence upon the community at large. Hence, enlightened governments provide and administer laws safeguarding the public health.

CLASSIFICATION OF DISEASES

Diseases may be broadly classified as *functional* and *organic*. Functional diseases are characterized by the arrest of a function of a part or all of the cells of an organ engaged in some essential duty involving the integrity of nutrition and elimination. So long as the disorder is purely functional, such cells or groups of cells do not undergo permanent structural change. When a structural change takes place in the cell or group of cells constituting an organ, just

so far has functional disease given way to organic disease.

A healthy functionating organ is capable of resisting, by its natural powers, surprisingly long-continued and often serious attacks upon its integrity. Such attacks commonly stand for the violation of well-recognized laws of health and may be referred to ignorance, inadvertence, weak will power, or unwholesome environment or occupation.

If the disturbance has not been too acute and is recent, the proper application of the rules of hygiene which shall correct the particular fault — get at the *cause* — is all that is necessary to a cure. It must be remembered that the impairment of one function sets up a "vicious circle" which operates on other functions, this in turn vitiating the natural physiological resistance of the fluids of the body to the invasion of infection. In this way, always insidious and at first scarcely noticeable to the victim, do the cells of the body fall prey to the degenerative changes which constitute acute and chronic organic disease.

The dividing line between functional and organic disease is not always to be recognized.

An organ may be partially destroyed and yet carry on its function in a fairly satisfactory fashion. A part of the lung may be destroyed, and yet nearly perfect health is maintained through the capacity of the rest of the organ to perform the function of that

destroyed. One kidney will often do the work of both when either has been removed. Sometimes an organ may be completely removed, and yet analogous structures carry on its work, as has been proved by the total extirpation of the stomach.

SYMPTOMS

A disordered function or disease is made manifest through abnormal sensations or feelings, called symptoms. Symptoms are called *subjective* when they are felt by the patient; *objective* when they are only to be known by the observation of the patient by another person.

Headache, pain, fever, are subjective symptoms and warn the patient of a disordered system. Albumen in the urine, the character of the pulse, are objective symptoms. It is the sum total of these which enables the physician to diagnose the abnormal condition.

DRUGS AS CURATIVE AGENTS

From the days of mysticism in medicine, to the present time, it has been sought to relieve symptoms and so cure disease by the administration of drugs. To find the "Elixir of Life" was one of the great goals of the alchemists.

The first use of drugs was purely empirical. That is, if the patient recovered by the use of a drug, it was assumed that the drug caused the cure, and was administered in similar cases.

Much valuable information has thus been obtained and incorporated in our materia medica. The mode of cure, the effect upon the tissues or functions as such, were not known. A notable example of the large empirical use of a drug was that of quinine upon its introduction. The curative uses of quinine are now known to be very limited.

Certain other drugs, like mercury and salicylates attained to the dignity of so-called specifics, *i. e.*, in certain affections their curative virtues were considered universal. This class of drugs is very limited.

HOW DRUGS ACT

A second class are the drugs whose action has been studied upon animals and their power over the various functions of the body noted, and this action applied to the modification of function to meet the requirements of disease. This class is very large, and its use constitutes the bulk of prescribing to-day. As knowledge of drug action has become more exact, empiricism has steadily given way to the modern prescription — a single drug, directed to a definite purpose. The so-called "shot-gun" prescription involved the combination of many drugs in the hope that Nature's selective power would supply the deficiency of the prescriber. It is now happily seldom seen outside of patent medicines. The use of drugs in the physiological sense, is the most exacting method of prescribing for the sick. It presupposes a clear

knowledge of the effect of the drug upon a given function and system at large

HOW DRUGS ACT. (PHYSIOLOGICAL ACTION)

The most commonly used drugs are anodynes — pain-relieving drugs. Opium and cocaine, antipyrine and acetanilid are examples. Opium acts through its influence upon the circulation of the brain, producing first an afflux of the blood to that organ and then a decrease of the same, through the nerve centers controlling the caliber of the blood vessels (vaso-motor nerves). In the absence of undue excitability of the nerves, there is produced a condition resembling normal sleep. In large doses its action is profound, producing the following effects: Profound stupor, complete anasthesia, paralysis of the respiratory centers, paralysis of kidneys, and finally from habitual use, profound changes in nutrition and in the psychic centers, resulting in emaciation, moral perversions and imbecility. Such drugs have a far-reaching effect, and are common ingredients of patent medicines.

Stimulants are such drugs as have for their primary action the stimulation of all the functions of the body, or exert their chief influence on some special function.

Alcohol is used as a general stimulant, while strychnine, belladonna, cannabis indica, digitalis, are examples of special stimulants, each acting through one or more nerve centers, yet all are rank poisons,

and destructive, not only of function, but of life, in excessive doses.

Hypnotics or sleep-producing drugs. In this class may be included some of the narcotic drugs, such as opium and cocaine. They operate through direct influence upon the brain. Chloral hydrate is the standard by which these drugs are judged. A pure hypnotic produces sleep, but does not relieve pain. They have secondary actions, which make their use hazardous by the unskilled.

Diuretics stimulate the function of the kidneys.

Diaphoretics act upon the sweat glands through their nerve supply, increasing perspiration.

Cathartics promote loose evacuations of the bowels, a class of drugs widely exploited by patent medicine vendors. They act in various ways, through stimulating the flow of bile, by stimulating the muscular walls of the bowels, by stimulating the secretion of the intestinal glands. Cathartics are widely used, and seldom with advantage, except for brief periods of time, and then should be selected for the special condition which calls for their use. The secondary effect of most cathartics is to intensify the abnormal condition they are used to overcome.

There are many other classes of drugs, and in each class are many drugs whose actions, in the main, are similar, yet whose differences render the choice a matter of knowledge and discrimination impossible for the layman to acquire.

There is not a function which can not be altered by drug action. There is hardly to be found a diseased function which may not be influenced for the better by the *wise* use of a drug. The converse is true. There is no drug, unless inert, which does not in some degree change a function, by acting upon one or more organs, either directly through its chemical activities, or its less well-understood, though more common, influence upon the tropic (nutrient) or other nerve centers. Not uncommonly drugs have a double action, and while beneficial in one direction are positively *harmful* in another. Yet such a drug may have its evil influence neutralized or balanced by one of opposite action combined with it. A group of drugs much used of late are good pain relievers or anodynes, yet they have a powerful depressing action upon the heart. A simple heart stimulant, combined with such drugs, eliminates, when judiciously used, the evil effect, while the desired effect is not impaired.

In this way many valuable combinations are brought about, greatly enlarging the field of scientific therapeutics. This seldom involves the use of more than one or two drugs. Often the happiest effects may be brought about in this way, and helpful action sustained over long periods.

OTHER METHODS

There are other methods of using drugs. The homeopathic method is the opposite of this physiologic.

If a remedy creates certain morbid manifestations in the healthy individual, it is administered for a similar morbid state when the result of disease. It is essential that the dose should not be sufficient to set up its physiological action. Ipecac causes, in large doses, excessive nausea and vomiting. In small doses it relieves nausea and vomiting.

Organotherapy. This branch of therapeutics, although in its infancy, promises large results. It is based primarily upon the theory that the secretions of certain organs of the body, by becoming deficient, take from the system an essential element which is necessary to the general well-being. The absence or disease of a small gland in the neck (thyroid), whose function was not known, was observed to be a constant accompaniment of a certain disease ending in insanity.

The same gland from a healthy animal was found to supply the deficiency and cure the disease when taken in small quantities. Investigation has proved the value of such remedies in a wide variety of diseases.

All use of drugs involves the wisest discrimination, based upon thorough familiarity with drug action, and with the organic structure and function of the human system, from the minute cell to the complete animal. This must be combined with knowledge of the condition and peculiarities of each patient.

DRUGS MAY HELP, NATURE CURES

While many drugs are capable of destroying cell life, there is yet to be known a drug which *can create*

a new cell. The power which creates the new cell, the vital force, may be favorably or unfavorably influenced by drug action. Or, the same drug may work harm or benefit, according to the dose.

Some of our most useful drugs, in which small doses have an effect upon the system of great usefulness, are destructive to life in larger doses. A drug which stimulates as its primary effect either over-stimulates on continued use, and thereby may permanently weaken, or tolerance is established, and increasing doses are required to keep up its effect.

The proper use of drugs, then, is to give some organ or organs of the body temporary assistance, and thus enable them to resume their normal functions Nature *only* can effect a lasting cure.

The prescribing of drugs for diseases and their symptoms has become systematized, and through their use many lives have been lengthened, at the same time the limits of their usefulness as curative agents are becoming better established, so that useless drugging, a practice until recently almost universal, is giving place to other rational methods of cure. For example, the use of electricity, massage, baths, open air and feeding (the most successful for tuberculosis); the wide scope of surgery which has invaded the field of medicine in many affections (epilepsy, ulcer of stomach).

The public attitude is well illustrated by this incident: A dressmaker called for relief from a long

train of nervous and dyspeptic symptoms. Her case was carefully reviewed, and she was advised as follows: "Join a ladies' gymnasium class. Take general exercise for an hour, in addition to the class lesson, each day. Eat only such food as your appetite demands. Take a brisk walk out of doors before each meal. Report progress in a month." There was a moment of some embarrassment, as the lady felt that the interview was ended. "But don't I get any medicine?" "No." "Well, you are the most peculiar doctor I ever heard of." She paid the fee with the remark: "Well, I hardly know what I am paying for." Yet in a month the patient returned a reformed, healthy woman, a result which probably could not be attained with the wisest use of drugs. This is the almost universal attitude at the present time, and the general public needs to be educated in the lesson taught by the incident.

THE ABUSE OF DRUGS

There is no greater responsibility to be assumed than that of advising the sick. It weighs heavily upon every practitioner, yet this great responsibility is shouldered with eagerness, not only by the sick, but by his neighbors. Where the trained scientist would hesitate, the worse than untrained layman is eager.

This general attitude is a relic of the days when ignorance of drugs was universal. No drug which

has any virtue as a medicine can be taken haphazard with impunity. If not directed accurately to its appropriate purpose within the system, it is an added burden to the sick organ, or is directly destructive of function, and handicaps Nature's effort at a cure.

Widespread harm arises from the misuse and abuse of drugs. That many survive such practices is true, but what of the many who are sacrificed? The neighbor or friend recommends only such patent medicines or other drugs as have come to his limited attention. He can know nothing of the disease, or of the drug's action. The laws of most states prescribe the amount of knowledge a physician must have before he may practice his art. Nor will his word be accepted, but he must pass an examination on all branches of medicine. The people are thus safeguarded from incompetency. Yet there is no law which protects the sick from the gratuitous unskilled counsel of his friends.

The law compels the druggist to attest full knowledge of the drugs he dispenses, yet permits the public to buy and use secret nostrums or patent medicines of the most vicious and demoralizing types. No law can prevent a willing victim from accepting advice, or the giver from giving advice. A proper appreciation of personal hygiene and the self-respecting application of the same will teach the folly of the indiscriminate use of drugs.

PATENT MEDICINES

The pure food law, which contains a clause on patent medicines, will perhaps ameliorate this to a limited extent. It requires a label bearing the per cent of alcohol, morphine, opium, cocaine, heroin, chloroform, cannabis indica, chloral hydrate or acetanilid on all sealed packages. A law which would limit a nostrum to its legitimate uses would be of service. The nostrum itself, in the vast majority of cases, is not only of little or no curative value; it is demoralizing to the patient.

Even more widespread is the harm brought about by the method of the advertiser in impelling its use by the sick. First, by lying in the most unscrupulous way about the effects and cures of his nostrum. Second, by false teaching, magnifying the least important and most common of morbid sensations to be the serious disease which the nostrum will cure (a backache means Bright's disease). Third, the creation of imaginary disease by suggestion, creating hopeless wrecks of their victims. Fourth, the immoral influences upon the unformed wills and minds of the young.

These are evils apart from the promiscuous effect of misused drugs. The postoffice department, by excluding from the mails such publications as lend themselves to this sort of iniquity, would soon bring about amelioration of this evil.

COMPOSITION OF SOME PATENT MEDICINES

CONTAINING A LARGE PROPORTION OF ALCOHOL

Peruna, 28%.
Paine's Celery Compound, 21%.
Lydia E. Pinkham's Vegetable Compound, 20%.
Ayer's Sarsaparilla, 26%.
Hood's Sarsaparilla, 18%.
Hostetter's Stomach Bitters, 44%.
Burdock Blood Bitters, 25%.

CONTAINING MORPHINE (OPIUM)

Mrs. Winslow's Soothing Syrup.
Kopp's Baby Friend.
Dr. Bull's Cough Syrup.
Fenner's Cough Honey.
Chamberlain's Colic Remedy.

CONTAINING COCAINE

Birney's Catarrhal Powder.
Dr. Cole's Catarrh Cure.
Gray's Catarrh Cure.
Crown Catarrh Powder.
Agnew's Catarrh Powders.
I. C. R. Instant Catarrh Cure
Prentzinger's Catarrh Balsam
Compressed Voice Tablets

CONTAINING ACETANILID

Orangeine
Bromo-Seltzer
Antikamnia
Royal Pain Powder.
Megrinine
Ammonol
Salacetin
Phenalgin.
Cephalgine
Dr. Davis's Headache Powders.
Anti-Headache.
Miniature Headache Powders.
Nerve Ease.
Klein's Kold Kapsules
Dr. Holbrook's Kold Powders.

Note.—The above list is taken from the reports of the Massachusetts State Board of Health, and the articles on "The Great American Fraud," published in Collier's Weekly on October 7, 28, November 4, 18, and December 2, 1905, and January 13, February 17, April 28, July 14, August 4, September 1 and 22, 1906.

When the National Pure Food Law becomes operative, after January 1, 1907, it may be expected that the composition of some of the patent medicines will be changed somewhat, as the law requires that a statement be made on the label of the quantity of certain dangerous drugs but not others.

PUBLIC HEALTH IN THE UNITED STATES

By Maurice LeBosquet, S. B.

Paper read at the Lake Placid Conference on Home Economics, September, 1906.

A few months ago, in the interest of our students, we began investigations of the work of the National and State Health Departments. If hygiene is the chief basis of home economics, the members of the Lake Placid Conference may be interested in the following report, which is by no means complete.

After some little inquiry, the health department of the central government was found to be a part of the Miscellaneous Division of the Department of the Treasury, entitled Public Health and the Marine Hospital Service. Surgeon General Walter Wyman is at the head of the Department which has charge of the marine hospitals, preventing the spread of epidemics, quarantine service and the public health. In 1905 this Department spent over a million dollars. Apparently only $20,000 was spent directly for sanitary inspection in the United States, the remainder being spent for maintaining stations and hospitals, in quarantine work, and in Cuba, South America and foreign ports.

The Board consists of 118 officers, surgeon generals and assistant surgeons, which maintains a hygienic laboratory in Washington for the examination of antitoxines, serums, etc. The Laboratory is also investigating various public health problems. The Yellow Fever Institute is continuing its inves-

tigations of yellow fever under the charge of the Public Health Department, and investigations in leprosy are in progress in the Hawaiian Islands. Other investigations are also in progress on cholera, the plague, hook-worm disease, prevalent in the southern states and Porto Rico.

Under the law of 1902 establishing the Department, the Public Health officers are authorized to hold an annual conference of the State and Territorial Health Boards in Washington. Four conferences have been held.

PUBLICATIONS

The annual report of the Department of Public Health and Marine Hospital Service—a book of about 500 pages—is made up chiefly of statistics and departmental reports, but contains a number of articles of interest. It is sent out pretty generally. The Public Health Reports are published weekly and are purely statistical, containing records of death throughout the United States.

The Hygienic Laboratory issues bulletins of technical and scientific interest. The Yellow Fever Institute has published fifteen technical bulletins relating to yellow fever.

The department issues no popular bulletins for general distribution.

Apparently the U. S. Department of Public Health is ably and efficiently administered. We know that it has done wonderful work in Cuba, the Philippines Porto Rico, and at the Isthmus of Panama. It stands ready to help out state authorities, as in the case of the recent epidemic of yellow fever in New

Orleans. The United States Department of Health should be given the credit of the discovery that yellow fever is transmitted only through the bite of the female of a certain variety of mosquito, and some of the credit for proving that malaria is transmitted in the same way by another species of mosquito.

STATE BOARDS OF HEALTH

A letter was sent out to all the prominent states asking for their last yearly report and any bulletin which they had for distribution, also that our name might be placed on the mailing list to receive future bulletins. Twelve annual and biennial reports were received, and a number of them contain interesting articles on a great variety of subjects.

In addition to the annual and biennial reports, which presumably all the State Boards of Health publish, quite a number of the state boards publish monthly, bi-monthly, or quarterly bulletins. We have received the following:

Maine—Bi-monthly bulletin, July, 1906, special tuberculosis number.

New Hampshire—Quarterly bulletin relating to pure food, sanitation, communicable diseases.

Vermont—Quarterly bulletin, special articles, pure food reports.

Massachusetts—Monthly bulletin, food and patent medicines analyses and reports of dairy inspection, mortuary statistics, reports of epidemics, showing causes.

New York—Monthly bulletin, chiefly statistics with brief articles.

Ohio—Monthly bulletin, articles and reports, yearly subscription 25 cents.

Indiana—Monthly bulletin, statistics, food work, brief articles.

Iowa—Monthly bulletin, news, book reviews, brief articles.

Wisconsin—Quarterly bulletin, brief articles.

Michigan — Quarterly bulletin, called "Public Health," rather long articles and extracts.

Colorado—Monthly bulletin, entirely statistical.

California—Monthly bulletin, statistics and brief extracts.

Doubtless other states issue periodical bulletins but we have not received them.

In addition to the monthly, bi-monthly or quarterly bulletins, many of the state Departments of Health issue pamphlets on the various communicable diseases, disinfection, etc. All these bulletins and pamphlets are issued primarily for the health offices in cities, towns and villages within the state of publication, but in many cases they are sent to any one interested outside of the state. Illinois is an exception to this. The office of the State Board of Health in all cases is located at the state capital, the secretary usually being the executive officer.

Michigan has undertaken educational work on hygiene to a greater extent than any other state. A law was passed in 1895 requiring every teacher to give oral and blackboard instruction relating to dangerous communicable diseases and other health matters. A series of teachers' bulletins and pamphlets was published. Over a quarter of a million

of some of these have been sent out since the law was passed.

One of the teachers' bulletins contains an intering estimate on the money value of public health work. The writer, from statistics compiled before and after the health crusade gives figures that seem to show about 2,000 lives are saved annually in the state of Michigan by combating smallpox, scarlet fever, typhoid fever, and consumption alone. Modestly reckoning the value of a life at $1,000, and that of a child at half price, considerably over a million dollars is saved yearly, or more than the total yearly state appropration.

In Vermont a law was passed in 1905 requiring the teachers to examine school children for defective eyesight and hearing. Charts and directions were prepared by the State Board of Health at a cost of only $700.00. Of the pupils examined, 33 per cent or nearly 15,000, were shown to be defective, the greater proportion having defective eyesight. Surely it was worth 5 cents each to find out these defects so that they might be rectified!

Many of the states have Laboratories of Hygiene and manufacture and distribute serums, anti-toxines, examine specimens for tuberculosis, diphtheria, etc., analyze public water supplies, and give advice for sewerage systems.

Although many of the State Boards of Health are performing their work admirably, and some of their bulletins are excellent, there seems to be a great deal of duplication of effort, especially in regard to printed matter. If the national govern

ment could be induced to issue a series of bulletins on the preventable diseases, disinfection and other sanitary matters, for free distribution, somewhat similar to the Farmers' bulletins, a tremendous educational work for hygiene might be inaugurated. Only a few thousand dollars would be required. A recommendation to the President or to Congress from the Lake Placid Conference might help.

SUGGESTION FOR THE RESOLUTION COMMITTEE

Whereas, Living men are the most valuable possession of the state, as health is of the individual; and,

Whereas, The health of the people must depend ultimately on the education of the individual; and,

Whereas, Over 300,000 lives are lost annually in the United States, and a vast amount of illness results from contagious and infectious diseases now known to be preventable;

Resolved, That Congress be petitioned to authorize the Department of Public Health and Marine Hospital Service to issue a series of bulletins, popular in character, for free distribution throughout the United States, on the various preventable diseases, such as consumption, pneumonia, diphtheria, typhoid fever, scarlet fever, whooping cough, measles, etc., on disinfection and on other health matters, and to make an appropriation for the same.

PLEA FOR A NATIONAL DEPARTMENT OF HEALTH

By Professor J. Pease Norton

In the next twelve months 750,000 persons will die in the United States, whose lives could be saved by proper effort. Unless the effort is made, the lives of 750,000 will be sacrificed.

Such is the tenor of a bulletin sent out recently by the Yale Department of Social Science.

The bulletin is a plea for the establishment of a national department of health by Prof. J. P Norton, head of the department. He says:

"There are four great wastes to-day, the more lamentable because they are unnecessary. They are, preventable death, preventable sickness, preventable conditions of low physical and mental efficiency, and preventable ignorance.

"Of the people living to-day over 8,000,000 will die of tuberculosis, and the federal government does not raise a hand to help them.

"The Department of Agriculture spends $7,000 000 on plant health and animal health every year but, with the exception of the splendid work done by Drs. Wiley, Atwater and Benedict, Congress does not directly appropriate 1 cent for promoting the physical well-being of babies. Thousands have been expended in stamping out cholera among swine, but not $1 was ever voted for eradicating pneumonia among human beings.

"In fact, the department of agriculture has expended during the last ten years over $46,000,000 But not a wheel of the official machinery at Washing-

ton was ever set in motion for the alleviation or cure of diseases of the heart or kidneys, which will carry off over 6,000,000 of our entire population. Eight millions will perish of pneumonia, and the entire event is accepted by the American people with a resignation equal to that of the Hindoo, who, in the midst of indescribable filth, calmly awaits the day of the cholera.

"During the next census period more than 6,000,000 infants under 2 years of age will end their little spans of life, while mothers sit by and watch in utter helplessness. And yet this number could probably be decreased by as much as one-half. But nothing is done."

Prof. Norton recommends the creation of a national department of health, having as its head a secretary who shall be a member of the cabinet. Under this department there should be created fourteen bureaus, as follows: Infant hygiene, education and schools, sanitation, pure food, registration of physicians and surgeons, drugs, druggists and drug manufacturers, control of institutions of public and private reliefs, correction, detention, and residences, organic diseases, quarantine, health information, immigration, labor conditions, research.

Such a department of health, Prof. Norton argues, might not only save 750,000 lives annually, but would add greatly to the productive wealth of the nation.

Estimating wages at $1 a day, Prof. Norton shows that $1,444,000,000 are lost every year by illness. A national department of health could save $500,000,000 of the amount every year.

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Nature and Health, Edward Curtis. ($1.25, postage, 12c.)

The Art of Right Living, Ellen H. Richards. (50c., postage 6c.)

A Natural Method of Physical Training, Chickley. ($1.50, postage 10c.)

How to Get Strong and How to Stay So, Blakie. ($1.00, postage 12c.)

Physiology for High Schools, Macy. ($1.10, postage 12c.)

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What a Young Girl Ought to Know, Mrs. Mary Wood Allen. ($1.00, postage 10c.)

What a Young Woman Ought to Know, Mrs. Mary Wood Allen. ($1.00, postage 10c.)

What a Young Wife Ought to Know, Mrs. Emma F. A. Drake. ($1.00, postage 10c.)

Beauty Through Hygiene, Mrs. Emma Walker. ($1.00, postage 10c.)

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Care of the Teeth, Samuel A. Hopkins. (75c., postage 6c.)

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Medical Inspection of School Children, Babcock. Published by Maltine Co., Brooklyn, N. Y. Free. (Postage 8c.)

TECHNICAL BOOKS.

A Text of Physiology, Howell. ($4.00, postage 34c.)

The Work of the Digestive Glands, Pawlow. ($2.00, postage 16c.)

Recent Advance in Physiology and Bio-chemistry, Leonard Hill. ($5.00, postage 26c.)

Note.— Any of the above books may be borrowed by members of the School for the cost of postage. Send stamps with request.

SUPPLEMENTAL PROGRAM ARRANGED FOR CLASSES ON

PERSONAL HYGIENE

MEETING I

(Study pages 1-29)

General Principles

Personal Hygiene, Pyle. Introduction. ($1.75, postage 18c.)
The Art of Right Living, Richards. ($0.50, postage 6c.)

The Human Machine

The Human Mechanism, Hough and Sedgwick; Chapters I-VII, XV. ($2.00, postage 18c.)

Physiology for High Schools, Macy; Chapters I-VI. ($1.10, postage 12c.)

Personal Hygiene, Pyle; Hygiene of the Brain and Nervous System. ($1.75, postage 18c.)

Story of the Living Machine, Conn. "The Cells." ($0.35, postage 6c.)

MEETING II

(Study pages 29-45)

The Senses

The Human Mechanism, Chapter XIV. "The Sense Organs."

Text Book of Physiology, Howell. Chapter XV, "Cutaneous and Internal Sensations;" Chapter XVI, "Taste and Smell." ($4.00, postage 34c.)

The Eyes

Personal Hygiene, Pyle. "Hygiene of the Eye."

The Human Mechanism. Chapter XXII.

Physiology for High Schools, Macy. Chapter VIII.

Nature and Health, Curtis. Chapter V. ($1.25, postage 12c.)

Text Book of Physiology, Howell. Chapter's XVII, XVIII, XIX.

Hearing

Personal Hygiene, Pyle. "Hygiene of the Ear."

Nature and Health, Curtis. Chapter VI.

Text Book of Physiology, Howell. Chapter XX.

Topic: Testing the Eyesight and Hearing of School Children. See "Medical Inspection of School Children," Prize Essay on Preventive Medicine, published by Maltine Company, Brooklyn, N. Y. (Free from the publishers; from the School, 8c.) Also Report of Vermont State Board of Health (4c, from the School).

Sample chart for testing eyesight with directions for use, loaned for 10c postage.

(Select a composite set of answers to the Test Questions on Part I and send to the School, with a report on Meetings I and II.)

MEETING III

(Study pages 45-56)

Digestion of Food

The Human Mechanism. Chapter VIII and pages 44-52.

Text Book of Physiology, Howell. Chapter VII and "Enzimes and their Action," pages, 657-665.

Work of the Digestive Glands, Pawlow. "The Psychic Juices." ($2.00, postage 16c.)

Personal Hygiene, Pyle. "Hygiene of the Digestive Apparatus."

Food and Dietetics, Hutcherson. Chapter XXIII. ($3.00 postage 26c.)

The Blood and Circulation

The Human Mechanism. Chapter IX.

Text Book of Physiology. Chapters XXII, XXIV.

Physiology for High Schools. Chapter XII.

Personal Hygiene, Woodhull. Chapter IV.

Respiration
The Human Mechanism. Chapter X.
Personal Hygiene, Woodhull. Chapter III.
Life and Health. Chapter I.

MEETING IV

(Study pages 54-104)

Nutrition
The Human Mechanism. Chapter XIII.
Text Book of Physiology. Chapters XLVII, XLVIII.
See article in *Food and Dietetics,* on "Proteid Metabolism," Folin; and article in *American Journal of Physiology* January 1905. (From the School, 4c.)
Recent Advances in Physiology and Bio-chemistry, Hill. Chapters X, XI, XII, XIII. ($5.25, postage 28c.)

Heat Product and Regulation
The Human Mechanism. Chapter XII.
Text Book of Physiology. Chapter LI.

Elimination
The Human Mechanism. Chapter XI.

(Select and send answers to the Test Questions on Part II and report on Meetings III and IV.)

MEETING V

(Study pages 105-136)

Hygiene of the Nervous System
The Human Mechanism. Chapter XVIII.
Personal Hygiene, Pyle. Pages 275–314.
Personal Hygiene, Woodhull. Pages 47–51.

Hygiene of Feeding

See *Food and Dietetics*, Norton. Volume VI of the "Library."
The Human Mechanism. Chapters XIX, XX.
Personal Hygiene, Pyle. Pages 26–48
Nature and Health. Chapters II, III, IV.
Food and Dietetics, Hutcherson. Chapters I, II, III, XXVII, XXVIII.

MEETING VI

(Study pages 137-187)

Hygiene of the Skin and Appendages

The Human Mechanism. Chapter XXI, Colds; Chapter XXIV, Bathing.
Personal Hygiene, Pyle. Pages 52–67; 82–92.
Personal Hygiene, Woodhull. Pages 124–133.
Nature and Health. Pages 204–210.

Clothing

The Human Mechanism. Chapter XXV and XXIII, Hygiene of the Feet.
Personal Hygiene, Pyle. Pages 72–81.
Nature and Health. Pages 191–203.

Physical Exercise

The Human Mechanism. Chapter XVII.
Personal Hygiene, Pyle. Pages 315–348.
Nature and Health. Pages 250–273.
How to Get Strong and How to Stay So, Blakie. ($1.00, postage 12c.)
A Natural Method of Physical Training, Checkley. ($1,50, postage 8c.)

(Send answers to the Test Questions on Part III, with a report of the last two meetings.)

INDEX

Home Care of the Sick

BY

AMY ELIZABETH POPE

INSTRUCTOR IN TRAINED NURSING, PRESBYTERIAN HOSPITAL, NEW YORK CITY

WITH PANAMA CANAL COMMISSION

CHICAGO

AMERICAN SCHOOL OF HOME ECONOMICS

1912

CONTENTS

AMERICAN SCHOOL OF HOME ECONOMICS
CHICAGO

January 1. 1907.

Dear Madam:

Good nursing consists chiefly in being able to render certain assistance deftly and correctly and to derive the full benefit from this course you must, so far as practicable, try to carry out the instructions given in the lessons.

Practice should not wait until you have a sick person on whom to experiment--your attempts might not be appreciated--but have someone "play patient" while you change the bed clothes, the gown, lift her up and down in bed, to another bed, to a chair, change the mattress, etc.

Do all this not once but many times until you can follow out the directions softly and quickly. It would be best to do this before the answers to the tests are sent in, so that if there is anything in which you fail or that is not perfectly clear, you can ask for explanations.

I regret that my new duties with the Panama Canal Commission will not permit me to look over your tests personally, but my substitute will, I know, give you all assistance needed. If I can be of any further help, I shall be glad to have you write to me even though an exchange of letters takes some time.

With best wishes for your success, I am

Sincerely yours,

Amy E. Pope

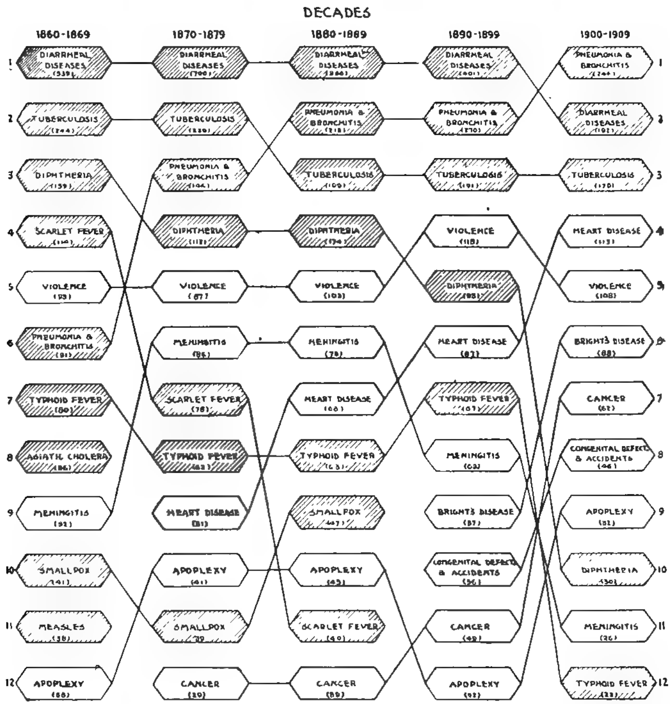
Supervisor

TWELVE CHIEF CAUSES OF DEATH IN CHICAGO.

BY DECADES, 1860-1909

CAUSES NAMED IN ORDER OF HIGHEST DEATH RATE.

AVERAGE RATES PER 100,000 OF POPULATION IN PARENTHESIS



THE PREVENTABLE DISEASES ARE INDICATED BY SHADING
NOTE THE GRADUAL ELIMINATION OF THE SHADY SPOTS.
DEPT OF HEALTH, CHICAGO- EDUCATION

HOME CARE OF THE SICK.

IT IS the minority, not the majority of people, who can afford the luxury of a trained nurse, especially in cases of protracted and chronic illnesses.

Aims of the Lessons

These lessons are intended to help those who cannot always command the services of a trained nurse, to teach how to carry out the doctor's orders, what to look for and observe in his absence, so that by giving him a definite report of what the patient's condition has been he may be able to work more understandingly, be able to diagnose the disease more quickly, be surer of how the patient is progressing, and of the influence the medicine ordered is having. And to teach above all how to handle and move patients without tiring them, how to render them comfortable, thereby ensuring rest of nerve and body.

The Doctor's Province.

What to do in illness is purposely omitted in these lessons, except in very simple troubles and in cases of emergency. The "what to do" is for the doctor to decide, the "how to do" for the mother to know. Incalculable harm is continually being done by the latter encroaching on the doctor's prerogative. Many a mother has treated her child for supposed colic and only called the doctor in after some days when the pain has refused to yield to her treatment. In very

many cases the treatment has been the worst thing possible for what has proved to be appendicitis, gastroenteritis, or other serious abdominal trouble.

What the Mother Should Know

There are few who can afford to run up the doctor's bill by calling him in unnecessarily. To avoid this, and yet not run the risk of endangering the lives of those entrusted to her care, especially the little children who cannot tell clearly where the pain is or how badly they feel, it is imperative that every mother should know how to count the pulse, take the temperature, and be cognizant of at least a few of the primary symptoms of the most common diseases, especially the contagious ones, where the lack of early recognition and isolation may imperil the health or life of others.

The following table gives the primary symptoms, period of incubation, and usual time required for isolation of the most common contagious diseases. The number of days between exposure to and the development of a disease is called the period of incubation.

FIRST SYMPTOMS IN SOME OF THE MOST COMMON DISEASES

CONTAGIOUS DISEASES

DISEASE	PERIOD OF INCUBATION	SYMPTOMS	TIME OF ISOLATION
Mumps	Days 14-21 average 18	Swelling of the glands between ear and jaw, on either side or both.	From day when swelling first appears till 10 days after, usually 3 weeks.

CONTAGIOUS DISEASES (Continued)

DISEASE	PERIOD OF INCUBATION	SYMPTOMS	TIME OF ISOLATION
Chicken-pox	Days 12-16 average 14	Slight fever, after 24 hours small pimples appear on back and face.	From onset until last crust has fallen, usually 14 days.
German Measles	Days 6-18 average 14	Very slight fever, rash (if any) appears first on face, may only last a few hours. There may be headache and nausea.	From 2 days before rash till symptoms are gone. Sometimes 2 weeks.
Measles	Days 9-16 average 12	Sneezing, running from eyes and nose, face swollen, sore throat, cough, fever gradually rising, rash appears first on face and neck.	From first catarrhal symptoms until desquamation ceases, usually 24 days.
Small-pox	Days 9-16 average 16	Chill, rapidly rising temperature, intense headache, pain in back and legs, rash, small, red, hard pimples, appearing first on face and wrists.	From onset until last crust has fallen, usually 6 weeks.

CONTAGIOUS DISEASES (Continued)

DISEASE	PERIOD OF INCUBATION	SYMPTOMS	TIME OF ISOLATION
Scarlet-fever	Days 1-7 average 7	Sudden vomiting, sometimes chill or convulsions, high temperature, sore throat, tongue coated on edges, bright red in center, general malaise, typical rash appearing first on chest and shoulders.	From appearance of rash till desquamation has entirely ceased; usually 6 weeks.
Diphtheria	Days 1-6 average 6	Especially in the beginning of the disease the temperature is not as high as in tonsillitis; headache, nausea, sore throat, with white patches on the tonsils.	From onset till germs have entirely disappeared.

As it is sometimes difficult even for the physician to distinguish between diphtheria and tonsillitis without taking a culture for examination, when white patches appear on a child's throat it should be isolated and a doctor called in at once.

DISEASES NOT CONTAGIOUS

Children's Diseases

Colic. Give castor oil, then a few drops of peppermint in hot water (never soothing syrup); keep the baby warm and lying on his abdomen. Gentle rubbing in a circular direction, and the application of hot flannels will generally relieve it. If not, a physician

should be notified as continued abdominal pain is a symptom of many serious disorders.

Cholera Infantum. Caused by over or improper feeding, heat and impure air. Symptoms: Diarrhoea and intestinal pain, excessive thirst, but no appetite. Try no home remedies, seek medical aid at once.

Intestinal Obstruction. Symptoms: Obstinate constipation, followed by vomiting and abdominal distention; usually not much temperature. Get medical advice promptly, as immediate operation may be imperative.

Convulsions. Caused by indigestion, worms, difficult dentition, or fright. Muscular twitchings coming on suddenly, sometimes even during sleep. Send for the doctor immediately, but do not await his arrival to put the baby in a hot bath. Give castor oil and an enema, according to directions given on page 55, using, if the child is small, a rubber catheter for a rectal tube.

Pneumonia. Primary symptoms: Chill followed by high temperature, cough, pain in chest, expectoration which gradually becomes rust colored and bloody. Put patient to bed and send for the doctor immediately.

Typhoid Fever. Primary symptoms: Temperature rising a little higher each day, nausea, headache, pain in back and limbs, nose bleed, sometimes constipation, sometimes diarrhoea, watery, yellow stools, abdominal pain. Put patient to bed and only allow liquid diet until the doctor comes.

Meningitis. May develop suddenly with continuous convulsions, or come on gradually with symptoms of fretfulness, restlessness, headache, vomiting, and intolerance of light and noise. Put patient to bed in a quiet, dark, well-aired room and only allow liquid diet till the doctor comes.

Croup. There are two forms of croup—the true or membranous and the false or spasmodic. The former is always associated with diphtheria, but since the use of antitoxine it has become a much rarer complication, seldom occurring when antitoxine is used. It comes on gradually.

False Croup

False croup comes on suddenly, generally in the middle of the night; it is as a rule the result of exposure to damp and cold, excitement, or indigestion.

The spasm is the result of the spasmodic closing of the glottis. Though not dangerous, it is very distressing and calls for immediate treatment. Relief usually can be obtained best by applying hot fomentations to the throat, inducing vomiting by giving a drink of tepid water and salt—a teaspoonful to the glass—and by steam inhalations.

The most effective way of giving inhalations is with the croup kettle and canopy. The quickest way to improvise these is to tie an umbrella to the top of the child's crib and over this drape two sheets, pinning them to the sides of the bed. They must overlap about one inch and hang down far enough over the sides and back of the bed to be tucked under the mat-

tress. The lower third of the front space is left open for the admission of fresh air. Water is kept boiling in a kettle at the back of the bed by a gas or oil stove

Canopy for Giving Steam Inhalations Made with a Sheet and Umbrella

and a cone of cardboard or stiff paper is attached to the spout and inserted between the overhanging sheets to carry the steam over the child's head.

Minor Troubles

In nearly all cases of slight indisposition, even diarrhœa, a cathartic such as castor oil or calomel, followed by salts such as Rochelle salts, magnesium sul-

Rear View of Croup Canopy Showing Stove, Kettle, and Tube for Steam

phate, or seidlitz powder, five or six hours later, together with rest and fluid or soft diet is indicated. *Give as little medicine as possible without a doctor's order.*

THE CHOICE, FURNISHING AND CARE OF THE SICK-ROOM

Sunshine, pure fresh air, and freedom from noise and odors are the principal things to be considered in choosing the sick-room. When possible it is advisable to have a room with a southern exposure. If there is a fireplace or grate in the room so much the better, as a chimney is an excellent medium for ventilation.

Despite the fact that the sick-room at the top of the house gives many stairs to climb, it is better to have it there. It is further removed from the noises of the street and house and the air is generally purer.

Furnishings

Only necessary articles of furniture should be retained; all heavy hangings, draperies, and upholstered furniture must be removed. Care must be taken, however, that the room is not made too bare and unattractive. Short, washable curtains; clean, white linen covers for the tables; a few fresh flowers will help to make the sick-room bright and cheerful. Flowers should be removed at night, the water they are in changed daily, and they should never be tolerated after they begin to fade.

The Bed

The ideal bed is iron or brass; single or three-quarter width. The double bed is unadvisable, for owing to its width, the mattress is apt to sink in the middle and it is then almost impossible to keep the under sheets drawn tightly enough to prevent wrinkles. The bed should be at least twenty-five inches in

height, but if it is not, can easily be made so by placing heavy blocks of wood under each leg. Hollows about two inches in depth should be made in the blocks to fit the ends of the legs. Especially if the patient is liable to be ill long, the trouble of doing this is well repaid by the added convenience in lifting and working over the patient.

The Mattress

A hair mattress is by far the best kind to have; the feather one the worst. Not only is the latter too heating, but when occupied it is almost impossible to make the bed properly.

The bed should be placed far enough from the walls to give access on all sides, care being taken to avoid having the light in the patient's eyes.

Lighting

The best plan is to have the window behind the bed; then more sun and light can be admitted without disturbing the patient. Except in certain cases, it is a mistake to keep the sick-room darkened.

Besides the bed, there should be two or three chairs in the room; one a comfortable arm chair with high back. If upholstered, it should be encased in a pretty, light, washable cover. Rocking chairs should never be permitted in the sick-room; when sitting in them one is almost sure to rock, and the motion is very apt to irritate the patient.

Two tables are necessary; on one should be kept writing material, where the doctor can write his orders and the nurse keep the record of the patient's condi-

tion. The second table can be near the bedside to hold the patient's bell; also her food-tray; the latter must always be removed as soon as the meal is finished. Never leave empty or half empty glasses of milk, cups of broth, etc., standing by the patient.

Bedside Table

There is a bedside table—made on purpose for use in the sick-room—which is very convenient. The top extends over the bed in front of the patient; it is adjustable and has a foot piece which goes under the bed and keeps the table from upsetting. (See page 30.)

Medicine bottles and all necessary utensils should be kept in an adjoining room, if possible.

The floor should be swept with a soft broom covered with cheese cloth, or other soft material which is free from lint. Carpets are very objectionable; small rugs which can be removed and shaken daily, being preferable. If the carpet must remain, see that it is kept well dusted, and that no dust is raised while doing so. The best way to do this to to sweep with a damp broom, going over it afterwards with a damp cloth pinned over the broom. Do not have this too wet or it will injure the carpet.

When it is necessary for the nurse to sleep in the room, the cot is the most convenient arrangement, as it is comfortable, inexpensive and can be easily removed in the day time.

Dusting

Never use a feather duster but clean, soft dust cloths which may be washed out every day. Except for the

varnished furniture, it is better to have the duster slightly damp, as this will prevent scattering of the dust.

Ventilation

The air in the sick-room must be as pure as the air outside. The value of fresh air as an aid to recovery is sadly underrated. The open fireplace is one of the best methods of ventilation. A current of air can be created in summer by placing a lamp or a candle in the chimney place, and in winter a wood or a coal fire. Next to a fireplace, an open stove gives the best means of ventilation.

Window ventilation is best obtained by double windows with double sashes. The lower sash of the outer window is raised about two feet; the upper sash of the inner window lowered about the same distance. The passage of air being thus directed upward, a direct draught upon the patient will not be produced, if windows and doors on the opposite side of the room are kept closed. Where there are single windows, the same effect can be obtained by tacking the lower end of a piece of cotton, about twelve inches in depth, to the frame of the upper sash and to the top of the window frame; then lower the sash about ten inches. When less air is desired the lower sash can be raised and a board fitted to the opening; the air then passes upward between the sashes.

Airing

In addition to this slight continuous ventilation, the window must be opened and the entire air of the sick-room changed at least twice a day. In doing this, be

careful that there is no draught and that the patient has extra blankets. If there is no screen at hand, a large umbrella will prove quite effective in protecting the patient's head from the direct current of air. If it is necessary to warm the air before it enters the patient's room, the window in an adjoining, well-heated room may be opened, the door between the rooms being left slightly ajar. The corridor or bath room (especially the bath room) should not be used for this purpose.

Fuel and Ashes

Hard coal should be used if the room is heated by a stove on account of its freedom from dust.

In removing the ashes, they should be sprinkled with water first to prevent flying, then quietly shoveled up. The coal can be added in paper bags filled outside, thus avoiding all noise likely to disturb the patient.

The temperature of the sick-room should be 68 degrees F at night and 70 degrees F during the day.

CARE OF THE PATIENT

A few essential points to be remembered in caring for the sick may be stated briefly.

Care of the Nurse

To properly care for a patient those undertaking the responsibility of the nursing must take proper care of *themselves*. Rest, recreation, and out of door exercise are positive necessities.

If the same member of the family has both day and night nursing to do she should always dress herself as comfortably as possible for the night. A cold bath

in the morning, with complete change of clothing, will be found very refreshing.

Dresses of light wash material should always be worn when attending the sick, but dresses and skirts must never be stiffly starched, as the rustling noise they make is very annoying to patients. Squeaking shoes are another abomination.

"Nevers" Never whisper in or near the sick-room.

Never discuss the patient's condition with her, or with anyone else in her hearing.

Never tell the patient what her temperature, pulse, etc., are, not even when they are normal.

Never tell the patient what medication you are giving her.

Never lean nor sit on the patient's bed, and be careful not to knock against it in passing.

When Speaking When speaking to a patient always stand in front of her, where she can see you; be particularly careful not to speak to her suddenly from behind, for when people are ill and nervous they are easily startled.

Keep door and window hinges well oiled; nothing is more aggravating than a squeaking door.

When windows rattle, wedge them apart between the sashes with pieces of wood or newspaper.

At Night Especially at night, or, rather, when getting ready for the night, attention must be paid to anything likely to prove a disturbing element to the patient's rest.

Before the patient goes to sleep see that you have everything at hand that you are likely to need for the

night: Extra blankets—a shade for the light, if necessary—coal prepared in paper bags, as previously described—milk—water—all the medicines you will require—ice, etc. Wrapping the ice in flannel or newspaper will keep it from melting. A hat pin makes an excellent and noiseless ice-pick. A large tin pan, enveloped in a blanket, will make a serviceable refrigerator in which to keep your ice, broth, milk and water.

A shade for the lamp or gas can be easily made out of green or other dark colored cambric, but be sure that the globe over which it is pinned is far enough from the flame to avoid scorching the cambric.

Bed Making

An uncomfortable bed is a great addition to the miseries of an invalid, therefore, one of the first essentials to be learned is how to make a bed.

The mattress is covered by a sheet, stretched tightly and tucked firmly as far under it as possible; folding the corners like an envelope helps to keep it firm.

The Draw Sheet

Another sheet called the "draw sheet" is also used under the patient; this is put on with the length across the bed, thus allowing a considerable fold under the mattress, thereby securing a further means of keeping the sheet tight. When putting the draw sheet on care must be taken to have it perfectly straight; it is first tucked in on one side, well under the mattress. In tucking in the second side it is best to begin in the middle, going first towards the bottom, then from the middle to the top, pulling it very tightly. The top sheet and blankets (single blankets are preferable to

double) should be put on separately, the corners being folded in, in the same manner as the under sheet. If it is not convenient to obtain a spread of dimity, or other light material, it is better to use a sheet, as the ordinary spread is heavy and gives comparatively little warmth.

Protecting the Mattress

When it is necessary to protect the mattress a rubber sheet is placed between the lower and draw sheets. White double faced rubber is the nicest for home use. The single faced rubber will answer the purpose and is cheaper, but it is not so easily kept clean. Either can be obtained at any rubber store.

When impossible to get the regular rubber sheeting thin oil cloth, such as is used for covering tables, will serve. In cases of emergency, several thicknesses of newspapers may be used until something better can be obtained.

CHANGING THE BED OF A HELPLESS PATIENT

Before starting to change the bedding be sure that you have everything necessary near at hand, and that the bed clothes are all well aired, perfectly dry and warm.

First take off the spread, fold it neatly; next take off the top blanket, and hang it out to air. Fold the other blanket and upper sheet over the patient, leaving the ends just long enough to cover her when you turn her over. This method answers a threefold purpose: (1) it has a neat appearance; (2) it replaces the

CHANGING THE DRAW SHEET

discarded blanket, and (3) the clothes are not in the way while you work. Loosen the lower sheets by raising the mattress with one hand while drawing out the sheets with the other. Raising the mattress is important, because the draw sheet has been tucked so far under the mattress that otherwise you risk not only jolting the patient but also tearing the sheets. Remove the pillows and if the patient does not object to lying flat for a while leave them out; if she does, one can be replaced. It is necessary to take them out to turn them and to make sure that there are no crumbs caught between them or in the pillow cases.

Changing the Night Gown

The night gown is the next thing changed. Have the patient lie on her back and flex her knees; if she is well enough she can easily raise herself while in this position; if not, place one hand under the buttocks and raise her, as you draw the gown up with the other hand, then raise the shoulders in like manner, drawing the gown up over them and the head before taking out the arms.

In putting on the clean gown roll the skirt up, and put the patient's head through the hole. Putting your hand through one sleeve grasp the patient's hand and draw it through; then do likewise with the other sleeve. The gown is then pulled down in the same manner as the soiled one was taken off.

The easiest way to change the under sheets is first to turn the patient on her side.

To do this, stand on the side towards which you will

turn her, slip one hand over and under her, with your arm slightly crooked, so that the hand and forearm will support and control one shoulder, the elbow support the back of the head, and the arm the other shoulder. Slip your other arm under the patient slantwise across the buttocks, so that the hand is under the small of the back. In this way the patient is well supported as you gently turn her towards you. If there is an assistant, one can hold her thus while the other manipulates the sheets; if not, and the patient needs to be supported, a pillow placed well up against her back will answer the purpose.

Turning the Patient

The sheets to be changed are folded close to the back of the patient, making the fold as flat as possible. The clean sheet is either folded fan shape or rolled to its centre, the roll or fold, as the case may be, is placed close to the sheet being removed, the loose edge is tucked in, as far under the mattress as possible, the patient is then rolled gently over on to the clean sheet, the soiled one removed, and the clean sheet well stretched, and tucked in according to the directions given in the making of the bed.

Changing the Draw Sheet

The top sheet is next changed. Placing the clean sheet over the sheet and blanket which are still over the patient; on top of this put the blanket which has been airing, draw the other blanket and sheet from underneath, then tuck in the clean ones, put on the second blanket, if one is necessary, then the spread, and arrange the pillows.

Changing the Top Sheet

The draw sheet, upper sheet, and night gown should be changed twice a day when the patient is not too ill; if they are not soiled when removed, air them well, after which they may be used again.

When the patient is not allowed to be bathed, her back should be washed with soap and warm water, rubbed with alcohol and powdered with talcum powder. This should be done while she is turned on her side for the changing of the sheet. When the night gown is closed in the back it is sometimes more convenient not to put the clean gown on until the patient's back has been washed. In such circumstances wrap a small shawl around the patient.

Special Gowns

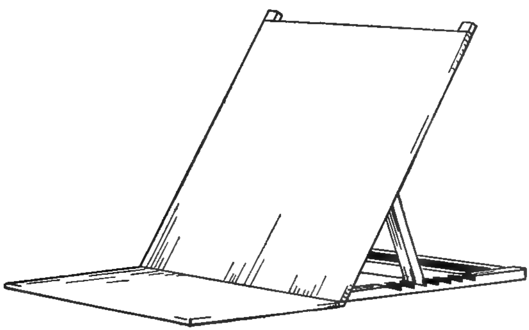
When for any reason it is inadvisable to move the patient, and it is necessary for her to lie on her back, it is convenient to have short gowns, open in the back, buttoned at the back of the neck and shoulders. The skirts can be drawn from under the patient, enabling her to lie on the sheet, which it is comparatively easy to keep free from wrinkles. Another important advantage of the short gown is the ease with which it can be changed. Large collars or ruffles at the neck of the gown are very objectionable in illness.

When changing the gown of a patient whose arm is disabled, the sleeve should be taken from the affected arm last, and the sleeve of the fresh gown put on first.

LIFTING AND HANDLING THE PATIENT

When lifting a patient it is important to stand firmly; to do this the feet should be placed well apart,

bracing one foot against the leg of the bed. Try to bend the back as little as possible, make the knees do the bending. In lifting, endeavor to have the weight come on your shoulders, not on your back. For example, when a patient is to be helped into a sitting position, bend your knees till your shoulder is only



A BACK REST, CANVAS COVERED.

slightly higher than the patient's, then have her put her arm across your shoulders, have your shoulder directly under her armpit, your elbow supporting her head, your hand under her other armpit—your other hand is thus free to arrange the pillows. Now raise the patient. By using this method your shoulder bears the burden, whereas if you attempt to raise the patient by bending your back, or if you have the patient's arm around your neck, the entire weight must

be sustained by your back, which will soon become strained.

The Back Rest

A back rest should always be provided when the patient sits up in bed for the first time. Many varieties of these are to be had, and they are inexpensive; some are made entirely of wood, others have a wooden framework with canvas stretched across it. A good substitute for the back rest is a straight back chair turned upside down. The pillows should be placed across the rest in such a way that the head will not be thrown forward and that the small of the back will be well supported.

Foot Brace

When the patient is obliged to sit up all, or nearly all the time, something should be provided for her to brace her feet against. A convenient arrangement for this purpose is a board the same length as the width of the bed and about twelve inches wide, placed between double folds of strong muslin which must be long enough to tie around the head of the bed when the board is supporting the patient's feet. The board may be padded on one side if desired.

Change of Position

When a patient has slipped down in bed and needs to be drawn up, place one arm under the shoulders in the usual crooked position so that your elbow may support her head, and taking a firm grip under the upper part of her arm, put your other arm under the thighs, and move the patient gently upwards. If well enough the patient can flex her knees and help in the movement.

If a patient is so heavy that two persons are required to move her, they should stand on opposite sides of the bed and reaching across the patient's back firmly grasp her under the armpits, their crossed arms thus forming a V-shaped rest for her head while they clasp each other's hands under her thighs.

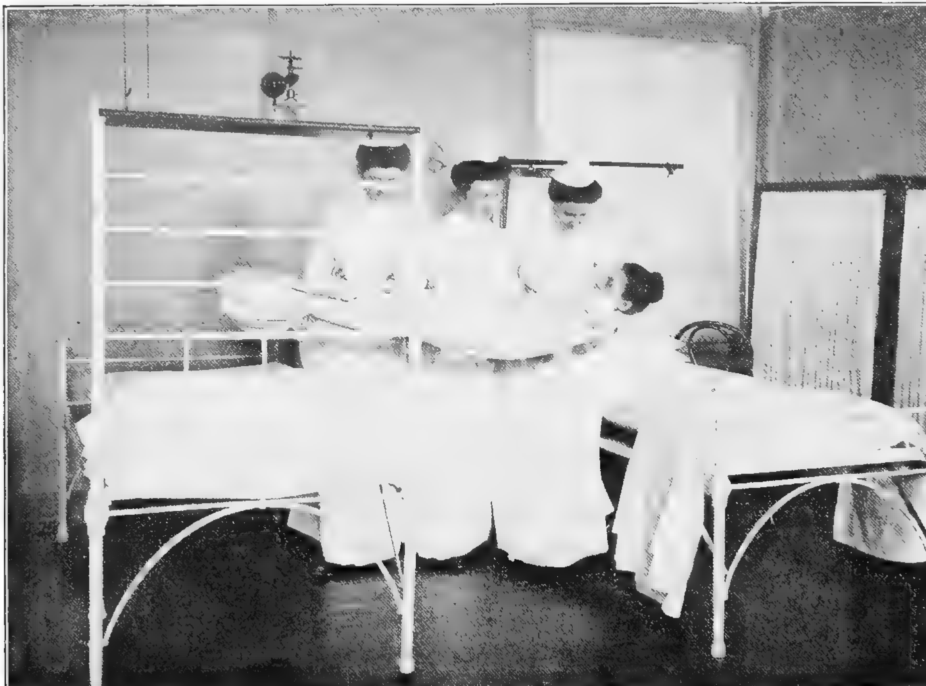
When the patient is well enough to help herself, putting a stout, broad piece of muslin round the foot of the bed with the ends long enough to be grasped, will help her to assume a sitting position; one round the top of the bed will help her to pull herself up higher in bed.

Changing the Patient from One Bed to Another

If necessary to change your charge from one bed to another, place the beds about five feet apart, parallel with each other, with the head of one on a line with the foot of the other. Unless the patient is very light there should be two to lift, both standing on the same side (between the beds). One puts her arms under the shoulders and buttocks, the other under the back and thighs. If possible have the patient hold herself stiff. Lift her gently in unison, turn round and place her on the fresh bed.

If the patient is heavy three may be required to do this well. Under these circumstances the first lifter supports the head and small of the back, the second the shoulders and thighs, the third the buttocks and under the knees.

When the lighting of the room or other considerations render it unadvisable to change the position of



CHANGING A PATIENT FROM ONE BED TO ANOTHER

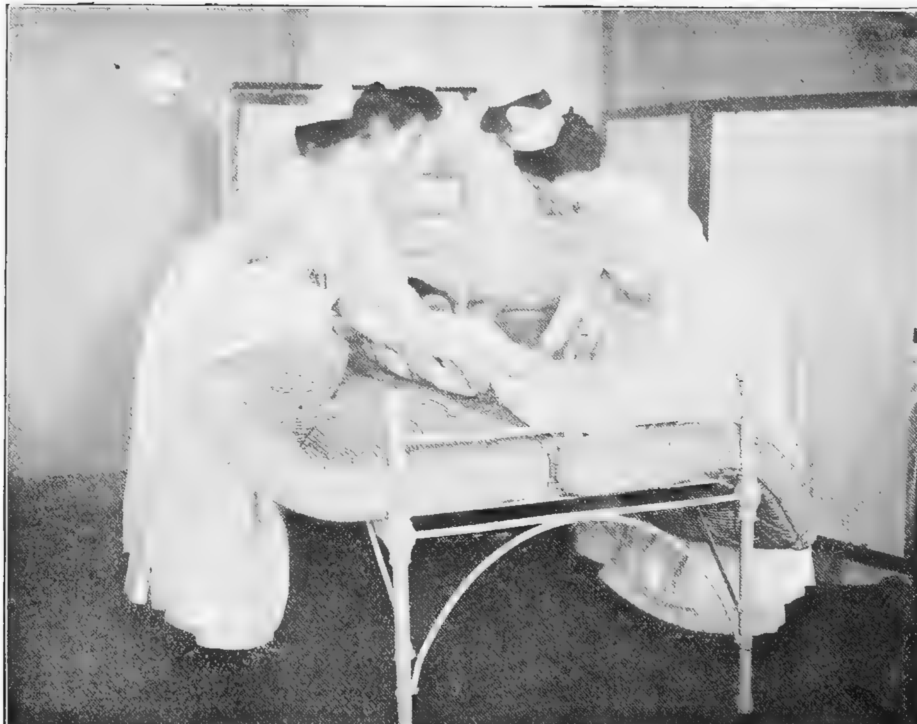
the head of the bed, they are placed near together with the heads on a line. The patient is lifted from the far side of the first bed, carried around between the two, and laid down in the second bed. This entails a longer carry, but if all work in unison it is not difficult.

TO CHANGE THE MATTRESS WITH THE PATIENT IN BED

To the uninitiated this seems an almost impossible feat. In reality, if done according to rule, it is not much harder than changing the under sheets. If the patient is heavy four people will be required to accomplish this deftly, two on either side of the bed. The sheets are loosened on all sides; the top sheets and the blankets treated in the same manner as when the bed clothes were changed; the under sheets are rolled tightly up to the patient's side (the roll being undermost). Using these rolls for support, the patient is moved to one side of the mattress; this side is then pulled to the centre of the bed, curving the mattress upwards; the fresh mattress is placed alongside, the patient lifted by the bed-clothes on to it, the discarded mattress removed, the fresh one drawn into place, and the patient lifted to the centre; the sheets are again unrolled and tucked in place.

THE PREVENTION AND CURE OF BED SORES

A bed sore is gangrene, or death of the tissue of the affected parts. The bony prominences such as the lower part of the spine, the shoulder blades, elbows,



CHANGING THE MATTRESS WITH THE PATIENT IN BED

and heels are the parts most likely to be affected. Moisture, wrinkles, crumbs, and a too long continuance in one position are the pre-disposing causes, therefore these conditions must all be guarded against.

Avoid Moisture

The presence of moisture is generally due to perspiration, or discharge from wound, bowels or bladder. When the two latter are the causes pads made of oakum or jute placed in cheese-cloth or old muslin, put on the patient like a child's diaper, will save the bed linen. These must be changed as often as necessary, and the patient well washed with warm water and soap; dusting with a little talcum, starch, or rice powder will help to keep the skin dry and soft and it will also prevent chapping. Crumbs and wrinkles must also be guarded against. By keeping the draw sheet tightly drawn and tucked far under the mattress the latter will be overcome; the former must be looked for after every meal; brushing them out with the hand is the most efficient way, but a small whisk-broom may be used.

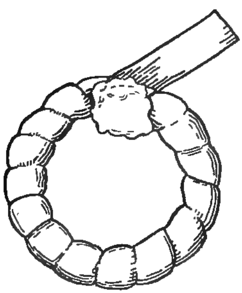
At least twice a day all parts likely to be affected, especially the back, should be washed with warm water and soap, rubbed with 50 per cent alcohol, and dusted with talcum. This not only helps to prevent bed-sores but is unspeakably refreshing to the weary invalid. Avoid using too much powder or it will cake and do more harm than good.

Artificial Skin

A preparation of equal parts collodion and castor oil painted over the surface will often prevent a breakdown of the tissue, by forming an artificial skin.

Relieving Pressure

Frequent change of position is another important means in the prevention of bed-sores. Prop the patient over on her side by putting a couple of pillows lengthwise behind her, one under her shoulders, the other under the lower part of her back. Rings made of batting or sheet wadding wound with bandages are excellent mediums for relieving pressure. They should be made with the hole just large enough to permit of the bony prominence fitting into it. When the patient has to lie for some time on her back, often considerable relief is given by flexing the knees. They can be supported either by a pillow doubled and tied to hold it so (the pointed side placed next the body), or a cylindrical pillow made like the old-fashioned bolster, only smaller and stuffed with hair. Small pillows or hot water bags filled with cool water, placed under the small of the back, will help to make a long continuance of the dorsal position bearable.



Wadding Ring,
to Relieve Pressure

All pillows should be shaken and turned frequently.

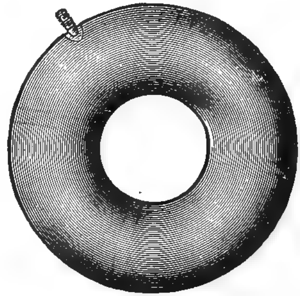
Care of a Sore

If the skin should become broken, the resulting sore should be washed daily with bichloride of mercury 1-2000, and a dressing applied. Gauze soaked in balsam of Peru or an ointment made of castor oil and zinc oxide powder are generally found efficacious.

CONVALESCENCE

The most anxious moments in nursing are certainly when the disease is at its height, but by far the most trying are, as a rule, during the time of convalescence. It is then that the greatest exercise of tact, discernment, self-control and patience on the part of the attendant are necessary.

Relapse, except in the germ diseases, is nearly always due to over-feeding, over-exertion, or nervous excitement.



Rubber Air Cushion

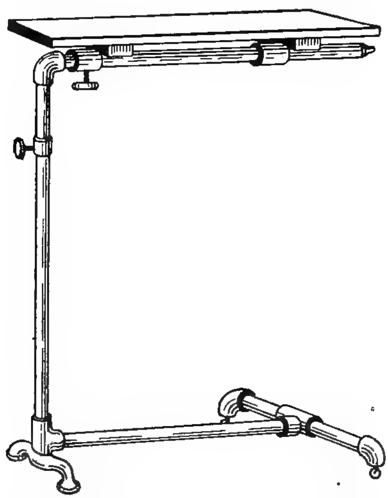
The diet is a very important factor in the treatment of convalescents. Carry out the doctor's orders minutely regarding it. Have, so far as you can, things that you know the patient likes. If she expresses a preference for a certain dish have it if allowable, but as a rule it is not wise to consult her on the subject.

Serving of Meals

Always serve your patient's meals as daintily as possible; have the tray covered with a spotless table napkin or tray cover; use the prettiest china available; even one bright flower with a little green is a great attraction. But above all see that the food is properly cooked and properly served; that all hot things are very hot, and cold ones really cold. More salt and less sugar will generally be wanted than when in

health. Highly seasoned food is not advisable or often desired even by those who like it when well.

It is better to set before the invalid too little than too much, for it is easy to get more, and the sight of too much food on the tray is apt to imbue anyone



A Bedside Table Convenient for Serving Meals

whose appetite is poor with a dislike for it. Besides, as the digestive functions are weakened during and after illness, it is better for a time to serve food in smaller quantities and oftener; for instance, give an egg nog, milk punch, egg lemonade, egg albumen, or other light, easily digested drink between breakfast

and the noonday meal, and again at three or four o'clock in the afternoon. A glass of hot milk given at bed-time will often induce sleep.

Amusing the Patient

Keeping the patient amused is another important item in the care of the convalescent. A few visitors (provided they do not stay too long, talk too much, or give any worrying or disagreeable news) will often help to brighten up the patient. Playing cards or games, reading aloud to her, etc., will help to pass away the time and tire her less than talking.

When people have been ill for some time the muscles of the eyes are apt to be weak and will be easily strained, so they ought not to be allowed to read much themselves, especially while they are in the recumbent position.

Sitting Up for the First Time

Those who are strong and well little realize the exertion and excitement caused by the first sitting up, after being confined to the bed for some time.

The period is usually limited to half an hour the first day, gradually increasing the time as the patient can stand it. Do not wait for her to complain of fatigue; on showing the first signs of it she should be put to bed. Of course there are patients who think themselves a great deal worse than they really are, and who have to be encouraged to sit up longer than they think they can. At such times the pulse is a good guide.

Do not really dress the patient until she is well enough to walk around. Warm stockings, bed slip-

pers, a warm wrapper and blankets are all that are necessary.

Lifting into a Chair

If the patient has been seriously ill she should not be allowed to stand or exert herself in the least when sitting up the first few times. If not too heavy she can be lifted by one person. The arms of the patient are locked about the neck of the attendant, who, placing one arm under the thigh, the other under the back, lifts the patient into the chair, the back of which is parallel with the foot of the bed.

When two people are required to do the lifting they should stand at the same side of the bed, placing the hands, one under the shoulders and buttocks, the other under the thighs and ankles, and lifting in unison, turn and seat the patient gently in the chair. The chair should be made comfortable with pillows, and the patient kept warm with blankets. When possible the chair should be carried carefully into an adjoining, well-aired room. The sick-room and bed should be well aired and made ready immediately for the patient's return, as it may be necessary for her to be put back to bed sooner than expected.

CARE OF THE HAIR, MOUTH, TEETH

While caring for the hair protect the pillow-case with a towel. When the hair is tangled always hold it between the tangle and the head to avoid pulling it. Rubbing a little vaseline into the scalp will help to get the snarls out more easily. To avoid tangles the

hair should be brushed twice daily and braided in two plaits.

If the scalp is kept clean by rubbing it occasionally with a little alcohol and water (equal parts) the hair always well brushed, and rubbed once in a while between a damp wash-rag, it may not be necessary to wash it for quite a while.

Washing the Hair

When it must be washed, protect the pillow and upper part of the bed with a rubber sheet covered with a bath towel. Pull the pillows down under the back so that the head extends somewhat beyond them and over a basin of water. Have a slop jar at hand in which to empty the water, and plenty of warm water to wash the soap out thoroughly. Support the head with one hand while you wash it. Dry the hair well after washing. A little alcohol or hair tonic containing it, well rubbed into the scalp, will lessen the chance of the patient taking cold.

Care of the Teeth

When the patient is unable to brush her own teeth it is often easier to do it for her with clean gauze wrapped around the index finger or the end of a piece of whalebone, than with a tooth-brush. In illness sordes (tartar) is apt to collect between the teeth unless they are very frequently and carefully cleansed.

Care of the Mouth

Clean not only the teeth but also the gums, the roof of the mouth and the tongue. Whalebone and gauze are far better for this purpose than the brush. When a patient is on milk diet her tongue and mouth should be cleansed after each feeding.

Some good mouth washes are:

(1) Equal parts of listerine, boric acid 4 per cent, lemon juice and water.

(2) Listerine, one ounce; peroxide of hydrogen, three drachms; alboline, one drachm.

(3) Tincture of myrrh, half a drachm; soda bicarbonate, grains twenty; aboline, one drachm.

(4) Listerine and water, equal parts.

BATHS AND BATHING

Perhaps there is nothing that will give greater refreshment to the invalid, obliged to lie in bed day after day, than a bath. Unless contrary to the physician's orders, one should be given every day. If given in a warm room, without exposure, there is absolutely no danger of the patient taking cold. To make matters doubly sure, before taking out of the bath blankets, rub the patient all over with 50 per cent alcohol.

The Cleansing Bath

Never give a bath until an hour after a meal. Before beginning see that the room is not only warm but free from draughts, also that you have everything needed at hand. It is best to have the water in a foot tub; it will keep warm longer than in a shallow basin. Have a pitcher of hot water to keep the bath the required temperature.

A large blanket, face and bath towels, wash cloths, alcohol and powder are the other necessary articles. Slip the blanket under the patient. If it is not wide enough to come well round her and also for the ends

to overlap, use two. The blanket may be covered by a sheet if necessary but the wool next the body is desirable.

Take off the night-gown and fold down the upper bed clothes—the face and neck are washed first and well dried, then the arms and hands. Be particular about drying between the fingers, also around and inside the ears. Especially while washing the face have a firm touch. Expose only one portion of the body at a time, and that not longer than necessary. Dry each part well before going on to the next; in order not to fatigue the patient, work as quickly as possible. It should be necessary to turn her only once. The towels should be warmed by wrapping them around a hot water bottle. It is well to give hot broth or milk soon after the bath.

The Foot Bath

To give a foot bath, loosen the bed clothes at the bottom, protect the bed with a blanket, put the foot tub, half full of water lengthwise on the bed, flex the patient's knees, raise her feet with one hand while you draw the tub under them with the other; wrap a blanket round tub and knees.

When mustard is desired, make a paste of the mustard—about two tablespoonsful to a large foot tub. The feet remain in about twenty minutes, the bath being kept at the same temperature by the addition of hot water from time to time. Be careful in adding the hot water not to pour it in near the feet.

When the bath is over wrap the feet in the blanket for a few minutes, then dry.

Baths for Reduction of Temperature

To give a bath for the reduction of temperature a large rubber (covered with a sheet) is necessary to protect the bed, as a considerable amount of water must be used.

There are several different kinds of bed baths given for this purpose. Sometimes the patient is simply sponged off with cold water, at others a hot sponge comes first, followed by the cold which often consists of equal parts of alcohol and water, made colder at times by the addition of ice. The doctor always orders the temperature of the bath, and also the duration, which is generally from ten to twenty minutes.

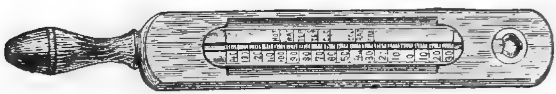
In giving these baths, use slow, long, curving, downward strokes, and plenty of water. Where there is a high temperature there is no danger of catching cold, and as eradiation of heat is the effect sought, the patient should be exposed as much as possible. It is often desirable, when the sponging is over, to rub the patient with alcohol, and fan till dry.

"Brand" Treatment

When possible, the "Brand" treatment is used for the reduction of temperature (especially in typhoid). For this, a portable tub, which can be wheeled to the bedside, is required. It would not be safe to give such a bath without the assistance of a doctor or trained nurse; it is, therefore, not worth while going into details, and, except in cases of long continued fever, the bed bath is generally all that is necessary.

When given a hot bath in a tub, fill the tub three-fourths full of water; the exact temperature will be ordered by the doctor, usually it is from 106 degrees F to 110 degrees F. The doctor also states how long he wishes the patient to remain in the bath. When giving a hot bath of any kind, for any purpose, always apply cold cloths or an ice cap to the head. A hot drink given either while the patient is in the tub

Hot Baths to Induce Perspiration, or Quiet the Nerves



BATH THERMOMETER

or after the return to bed will further induce perspiration. Mustard is sometimes added to these baths, just as it is to the foot bath.

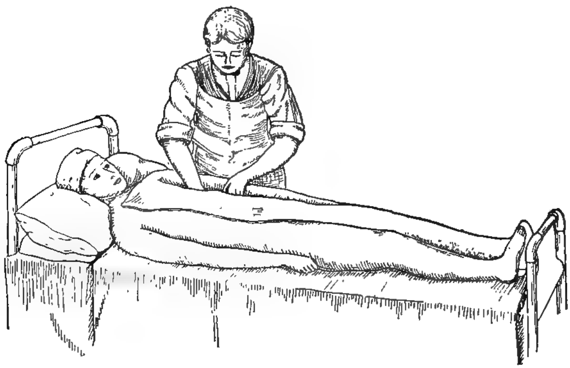
Precautions

While in the tub the patient's pulse must be noted carefully, as such baths are sometimes very depressing to the heart. After the bath the patient must go to bed immediately, and remain there well covered, and care must be taken to have warm clothing going from the bath to the bed. These baths are also given to children in convulsions.

The Hot-pack or Sweat

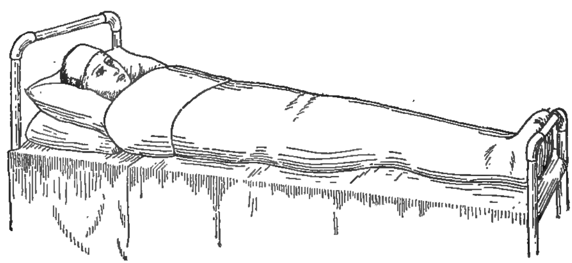
The hot-pack, or sweat, is generally considered a better medium for inducing perspiration. To give this protect the bed with a rubber sheet or oil cloth, wring out two old blankets in water 130 degrees F, put one under the patient and around one arm and leg, the

other over the patient and around the other arm and



GIVING A HOT-PACK

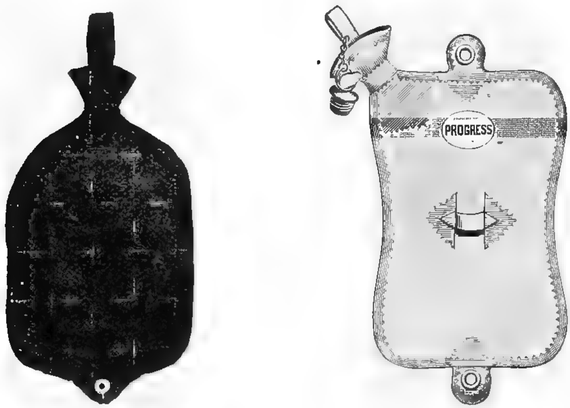
leg; put an ice cap or cold compress on the head, a hot water bag at the feet, another over the heart,



HOT-PACK COMPLETED

others along the side, over all wrap a couple of dry blankets; give a hot drink. The patient generally re-

mains in the pack from twenty minutes to half an hour. The pulse should be taken every five minutes, and as



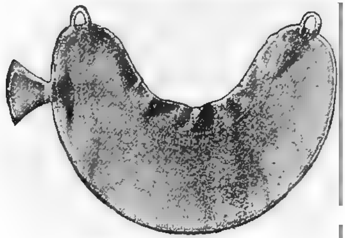
HOT WATER BOTTLES

the hands are under the blankets it must be taken at the temporal artery.

HOT WATER BOTTLE FOR THE SPINE

After being taken out of the pack the patient should be rolled in a dry blanket and remain so for an hour.

Except where a light weight is desirable, as over the heart and abdomen, a good substitute for the rubber hot water bag is a stone bottle; even a glass one can be used, and if a wire a couple of inches longer than the bottle is put into it to act as a heat conductor, it can be filled with quite hot water without breaking. When using hot water bags or bottles of any kind, precautions must be taken to avoid burning the patient, which is very easily done, especially with old people, or where from any cause, the circulation of the blood is sluggish or the tissues in poor condition; therefore, see that the bottles are tightly corked, that they are well and securely covered (flannel bags slightly larger than the bottles make the best covering); never put them too near the patient, and remember that when the patient is restless the bags are apt to slip nearer than you intended them to be.



Water Bottle for the Throat

Salt Baths

Salt baths are given for their tonic effects. A bath sufficiently strong to redden the skin and have an exhilarating effect will require ten pounds of ordinary sea salt to a bath tub about half full of water.

The average standard temperature for baths is as follows:

Cold......33°-65° Fahr.	Tepid.85°- 92° Fahr.
Cool......67°-75° Fahr.	Warm92°- 98° Fahr.
Temperate.75°-85° Fahr.	Hot..98°-112° Fahr.

The regular bath thermometer is encased in wood to protect it from hard usage, but the ordinary atmospheric thermometer will answer the purpose just as well. Mix the water well before taking the temperature.

SICK ROOM METHODS

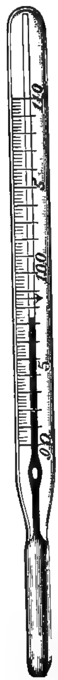
Taking and Recording Temperature, Pulse and Respiration
Observation and Recording of Symptoms

The heat of the blood is ascertained by means of the clinical thermometer. These thermometers are self registering and vary in delicacy, the finest ones registering in one minute, others in from three to five minutes. The more expensive ones magnify the scale, and are therefore easier for the novice to read. Hick's thermometer is probably the best. **Clinical Thermometer**

The temperature is taken either in the mouth, rectum or armpit. Before using the thermometer the mercury must be shaken down to 95°. Be careful not to shake it into the bulb, or the thermometer will be rendered useless and also be careful not to hit it against anything, as it will break very easily. While in constant use it is best kept in a glass containing a little boric acid or listerine, with some soft cotton in the bottom of the glass.

Temperature by Mouth

When taking the temperature by mouth be sure that the patient has not had anything to eat or drink recently. Place the end of the instrument containing the mercury under the tongue, on either side. See that the lips are tightly closed all the time the thermometer is in the mouth, and do not leave it in place longer than necessary.



Clinical Thermometer

Never take the temperature of a delirious patient nor a child by the mouth; they are likely to bite off the bulb and swallow the mercury. If this accident should occur give white of egg immediately and notify the physician. In such cases it is always safer to take the temperature by rectum and it is also expedient to take a rectal temperature when the patient is very ill, for this is the most accurate method.

Before inserting the thermometer, the bulb should be oiled and precautions taken to have the rectum free from faeces. Five minutes should be allowed for registration. The temperature will be one degree higher than when taken by mouth.

The axillary temperature will be from three-tenths to half a degree lower than the mouth. The armpit must be wiped thoroughly before taking; the thermometer is then placed in the hollow, and kept in place by holding the arm close to the side and flex-

ing the elbow so that the hand rests on the opposite shoulder. It will take ten minutes for the thermometer to register.

Normal Temperature

The normal temperature of the human body is from 98° F. to 99° F. The temperature is apt to be highest between 4 p. m. and 8 p. m. and it reaches the lowest ebb about 3 a. m. This fact makes it essential that special care be taken of the sick in the early hours of the morning, the lowering temperature indicating a lower vitality.

High Temperature

Though a rise of temperature is always to be regarded with suspicion it must be remembered that many causes (especially with children) may create a slight deviation from the normal, without anything serious being the matter. Constipation will often cause a rise of temperature, sometimes even a slight cold, attack of indigestion, or undue excitement will do the same, while profuse perspiration or diarrhœa is apt to cause a sub-normal temperature.

Sub-Normal Temperature

A sub-normal temperature is far more dangerous than the same number of degrees above normal. If a patient's temperature drops to 97.5° or 97° she should be rolled in blankets, a hot water bag put at the feet, another over the heart, and a cup of hot coffee or milk given. If the temperature does not soon respond to this treatment the doctor should be notified.

The following table gives the different variations of temperature:

Hyperpyrexia....105° and over, extremely dangerous

High Fever	103°	105°
Moderate Fever	101°	103°
Sub-febrile	99½°	101°
Normal	98°	99½°
Subnormal	97°	98°
Collapse	95°	97°

Algid Collapse......Below 95°, extremely dangerous

Temperature Records

A record of the temperature is of great value, not only in diagnosis, but also in watching the course of the disease; it should therefore be charted every time it is taken. This can be done in figures, but the regular clinical temperature chart conveys a clearer idea of how the temperature is running. The temperature should be taken at the same time each day; when it does not deviate much from the normal twice a day, morning and evening, is sufficient; otherwise it should be taken every three or four hours, according to the nature of the case.

The Pulse

A thorough knowledge of the pulse can only be gained by constant study and practice. It takes many months of careful observation of the numerous cases in the hospital ward, before the medical student or nurse can readily discern between the various characteristics of the different pulses. It is, therefore, impossible to go very deeply into the subject here.

The three principal things to be learned are: (1) How to count it; (2) to discern if it is regular or irregular; (3) if strong or weak.

To Count the Pulse

To count the pulse place the index and middle fingers on the wrist, on the thumb side, where the radial artery can easily be felt. Count it for a full minute, dividing the minute into quarters, as you can then tell if the frequency of the pulse is regular or irregular. For instance, if you count fifteen beats in one quarter and twenty in another, you will know that the frequency of the pulse is irregular.

If some beats are strong and others weak the quality of the pulse is irregular. By careful consideration of the pulse every time you take it, it soon becomes possible to realize where there is a difference in the quality of the pulse; that is, when it is stronger or weaker.

Pulse by Temporal Artery

The pulse can be taken at the temporal artery when for any reason it is impossible to take it at the wrist, it also can be felt in the groin.

The average normal pulse is:

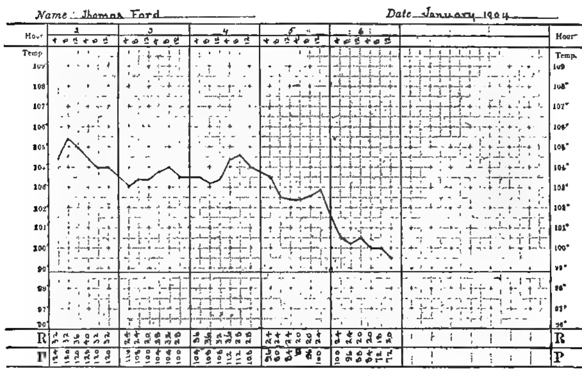
In men from...........60 to 70 beats per minute
In women from.........65 to 80 beats per minute
In children from........90 to 100 beats per minute

Just as the temperature, even in health, is affected by certain conditions, so is the pulse; food, exercise, excitement, will all cause an increase in the pulse rate.

The pulse should always be taken and recorded at the same time as the temperature. The pulse is generally written in figures. When there is any difference in the quality, or if it is irregular this also should be recorded.

The Respiration

A record of the respiration is also often required. The respiration being more or less under the control of the patient it is never wise to let her know that you are taking it; therefore, keep hold of her wrist, as though you were still counting her pulse, and watch the rise and fall of the chest. If you find it hard to



TEMPERATURE, PULSE, AND RESPIRATION CHART

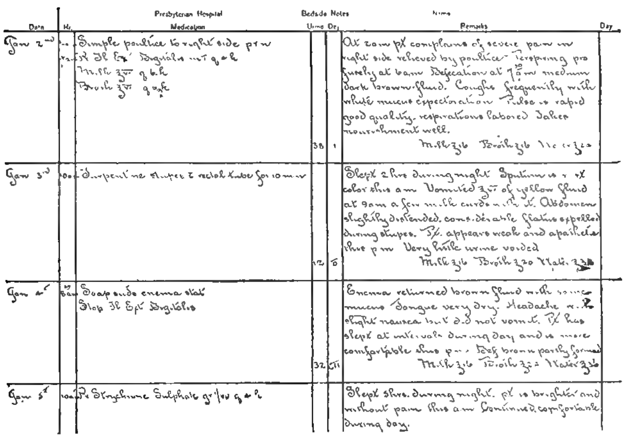
count by simply looking, hold the patient's hand on her chest, then you can feel the motion as well. This is generally the easier method for the beginner. Count it as you do the pulse. for a full minute in quarters. The inspiration and expiration count as one breath.

Keeping Records

Besides the temperature, pulse and respiration, a record must be kept of all medication given, and also of all changes in the patient's condition. If the patient has pain note it, stating where the pain is and

if it be continuous or only in paroxysms. When medicine is given to relieve the pain state with what result. When the patient is on liquid diet, the amount of fluids taken during the twenty-four hours should be charted every morning.

Mark every movement of the bowels; observe the



Presbyterian Hospital — Bedside Notes — Name

Date	Hr.	Medication	Urine	Def.	Remarks	Day
Jan 2nd	[illegible]	Simple poultice to right side p r n Tr. Fl. Ext. Digitalis m v q 4 h Milk ℥ iv q 2 h Broth ℥ iv q 4 h	38	1	At 2 a m pt complains of severe pain in right side relieved by poultice. Perspiring profusely at 6 a m Defecation at 7.30 a m medium dark brown fluid. Coughs frequently with white mucus expectoration. Pulse is rapid good quality, respirations labored. Takes nourishment well. Milk ℥ 16 Broth ℥ 16 [illegible] ℥ [illegible]	
Jan 3rd	10 [illegible]	Turpentine stupes c rectal tube for 10 min	12	6	Slept 2 hrs during night. Sputum is [illegible] color this a m Vomited ℥ iv of yellow fluid at 9 a m a few milk curds with it. Abdomen slightly distended, considerable flatus expelled during stupes. Pt. appears weak and apathetic this p m Very little urine voided Milk ℥ 16 Broth ℥ 20 Water ℥ [illegible]	
Jan 4th	[illegible]	Soap suds enema stat Stop Fl Ext Digitalis	32	[illegible]	Enema returned brown fluid with some mucus. Tongue very dry. Headache [illegible] slight nausea but did not vomit. Pt has slept at intervals during day and is more comfortable this p m Def brown partly formed Milk ℥ 16 Broth ℥ [illegible] Water ℥ 16	
Jan 5th	10 a m	Rx Strychnine Sulphate gr 1/60 q 4 h			Slept 5 hrs. during night. Pt is brighter and without pain this a m Continued comfortable during day.	

BEDSIDE NOTES AS MADE IN A HOSPITAL

movements carefully to see if there is anything abnormal in their appearance. If so, not only describe it in your record, but save the movement for the doctor's inspection. The same thing should be done if the patient vomits.

When there is not sufficient urine voided, report it; also if there is anything untoward in its appearance.

Forty ounces is the amount that should normally be voided in twenty-four hours. In fevers there is apt to be less, and what is passed will be highly colored. In nervous diseases, on the contrary, there is likely to be a larger amount of a pale color. Perspiration, a chill or chilly feeling, coughing, expectoration, restlessness, the amount of discharge from wounds, are all items of import of which the doctor must know the details to treat the patient understandingly. He never will fully know them unless they are clearly and concisely written down at the time they happen.

Important Items

The accompanying temperature chart and record is an example of hospital practice.

THE GIVING OF MEDICINE

A few rules to be remembered in giving medicines are:

Rules

1. Always give exactly what the doctor orders, neither more nor less.

2. Always give medicine on time—if a dose is due at twelve, give it at twelve and not at half past.

3. Medicines intended to be taken before meals should be given twenty minutes before meal-time, those to be taken after eating, twenty minutes after the meal is finished.

4. Never give medicine without reading the label on the bottle twice; before and again after pouring it out.

5. When pouring medicine always hold the label on the upper side, to avoid defacing it.

Measuring

6. Do not use spoons for measuring for they are never accurate; small graduated glasses, which are infinitely better, can be bought at any drug store for about ten cents.

7. When pouring hold the mark of the quantity you require on a level with your eye.

8. Always shake the bottle before pouring out the medicine.

9. The bottle should always be recorked immediately after use, for many medicines contain volatile substances and are apt to become either stronger or weaker than intended, if left uncorked.

10. Medicines containing iron should be taken through a glass tube or straw, as they discolor the teeth.

11. Some medicines, notably several that are given for coughs, should be given undiluted, while others on account of their irritating properties should be very well diluted. Never dilute more than necessary, for the addition of a large quantity of water often renders a disagreeable dose still more unpleasant to take.

To take away the Taste

12. Holding a piece of ice in the mouth for a short time before taking medicine will often render a disagreeable flavor less noticeable; a drink of seltzer afterward will help to "take away the taste." Castor oil given with lemon juice, a piece of ice small enough to

swallow, seltzer added just before taking, and a drink of seltzer after, is not at all unpalatable. Holding the nose while taking medicine will also diminish the taste.

Powders and Pills

13. Insoluble powders such as calomel, bismuth and acetanilid should be placed far back on the tongue and washed down with a swallow of water. Those with a disagreeable taste can be given in jam or bread or encased in wafers or capsules which can be bought for the purpose.

14. Pills also can be made easier to swallow by giving in bread or jelly. Unless pills are freshly made, they should be pulverized, as they soon become so dry and hard that they will not readily dissolve in the stomach.

15. Never buy a large quantity of medicine at a time, there are very few kinds that will not deteriorate by keeping; and because a medicine is beneficial in one case, do not imagine that you can give it to everyone whom you may think has the same ailment.

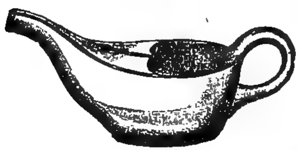
16. Medicines should be kept in a cool, dry place and properly labeled. All poisons should be marked as such and kept under lock and key.

Injections

Medicine is occasionally given by rectum, either when a local effect is desired or when the stomach is unable to retain it.

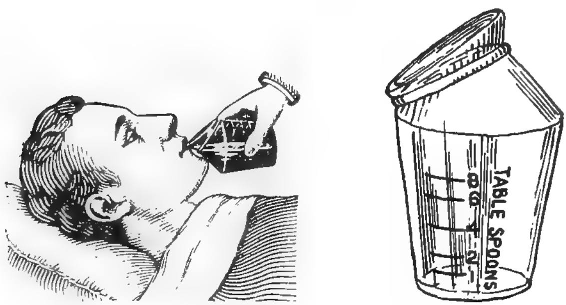
When medicine is given by rectum it is generally ordered well diluted. The water, added for this purpose, should be warm enough to make the injection about

100° F. A rubber rectal tube, or a large size rubber catheter, connected by a glass connecting tube with a piece of rubber tubing about eighteen inches long, into the further end of which has been fitted a small glass funnel, are the best in giving medicinal enemata.



Porcelain Feeding Cup

Let warm water run through the tube to be sure that it is in working order; this will also heat it and thus avoid cooling the medication. Grease the tube well, with oil or vaseline, and before inserting it fill the funnel with the solution, allow half of it to run



GLASS DRINKING CUP

through, back into the pitcher, pinch the rubber to prevent the rest running through. This is done to avoid getting air into the intestine.

For sedative enemata (these generally consist of bromide or chloral) the tube is only inserted about six

inches, but for stimulating enemata (brandy or whisky and salt solution) and nutritive enemata, the tube is inserted about fourteen inches, and a small pillow placed beneath the hips to help the upward flow. When giving these enemas have the patient lie on her back. Holding a folded towel to the anus, after the removal of the tube, will help the patient to retain the injection.

Nutritive Enemata

Nutritive enemata generally consist of peptonized milk, white of egg, salt and one of the beef preparations made especially for that purpose; but every doctor has his own formula and will specify how he wishes it prepared. When patients are having nutritive enemata constantly they must have a cleansing enema daily, and this must be given at least an hour before the next nutritive one is due, and not till two or three hours after the last one has been given.

Starch and other emollient enemata are sometimes given in diarrhoeas and dysentery. To prepare the starch mix a teaspoonful of laundry starch in cold water, add a teacupful of hot water, let it come to the boil. A few drops of laudanum are sometimes added to this; when it is ordered, be very accurate in counting the drops.

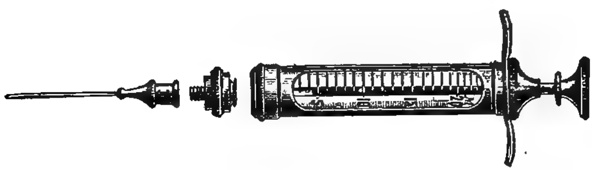
Suppositories

The suppository is another method of giving rectal medication. This is a conical shaped preparation of cocoa butter in which the required drug is incorporated. It is oiled and gently inserted, pointed end foremost, the patient lying on the left side.

Medication for the throat is often given by means of the atomizer. When using this see that the patient's tongue is held down sufficiently to allow the spray to reach the affected parts, and be careful not to let the end of the atomizer touch the back of the patient's throat, as this tends to induce vomiting.

Inhalations

The inhalation of vapor is another method of conveying medication to the throat and also to the bronchial tubes and lungs. Mix the medicine with boiling water and put in a small kettle over an alcohol lamp. With stiff brown paper, make a cone, one end to fit over the mouth and nose, the other over the spout of the kettle.



HYPODERMIC SYRINGE

Hypodermic Injections

When rapid absorption is necessary medicine is sometimes given hypodermically. The hypodermic is a graduated syringe to which a hollow needle is attached. As hypodermic injections are attended with great danger unless properly given, no one should attempt to administer medicine this way without being personally instructed by a physician or nurse. In giving medication hypodermically, the greatest cleanliness should be observed; the flesh, where the injec-

tion is to be made, must be well washed with alcohol, the needles should be attached to the syringe and alcohol drawn into the syringe and expelled several times before the medicine is drawn in. When the syringe is filled with the required amount, expel the air by pointing the needle upward and gently pressing the piston till a drop appears at the point of the needle. Be careful not to let the needle touch anything after it has been cleaned—if it should, hold it in the alcohol again for a minute before inserting. The injection may be given in the outer side of the arms, thighs or abdomen. Hold the flesh between the thumb and first finger of the left hand, plunge the needle in with one quick downward movement, inject the fluid slowly by gently pressing the piston. Draw the needle out quickly. Rub the spot where the injection was made for a few seconds to hasten absorption.

Clean the instrument with alcohol before putting it away.

PURGATIVE, ENEMATA, DOUCHES AND CATHETERIZATION

Cleansing Enema

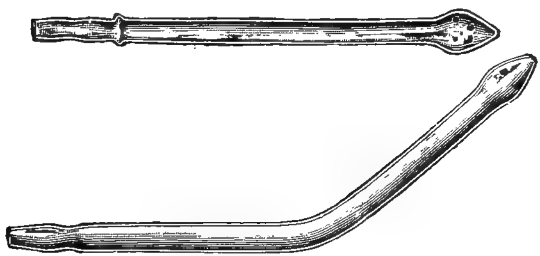
The purgative, or as it is also called, cleansing enema, is given as its name indicates for the purpose of washing out the intestines. It is generally resorted to when cathartic medicine fails to act, when immediate catharsis is necessary, or when for any reason the patient is unable to take a cathartic by mouth.

The long rubber rectal tube is the best appliance for

the giving of such enemata; the water is injected higher into the bowel and there is a steadier flow than when any of the bulb syringes are used. This can be attached by means of a connecting tube to the tube of the ordinary fountain syringe bag. See that the stop cock is on the tube.

Soap Enema

The cleansing enema generally consists of a soap



GLASS DOUCHE NOZZLES

suds made with "ivory" or castile soap; the froth of which should be removed as it contains too much air; the temperature should be about 98°F. Make the soap suds in a pitcher, pour it into the bag, let some run through the tube to warm it and expel the air, shut the stop cock, grease the rectal tube. Hang or hold the bag not more than three feet higher than the patient.

The bed should always be protected with a rubber sheet and large towel, the patient lies on her left side with the knees well flexed. The tube should be in-

serted very gently, never use force, let the water run in slowly. If much pain is given shut the water off occasionally, for a minute or two. When a sufficient quantity has been given (two to three pints for an adult, one for a child) remove the tube quickly, but gently, and press a folded towel to the anus. The fluid to do much good should be retained from fifteen to twenty minutes.

After use the tube must be carefully cleansed, wash it in warm soap suds and water, afterward let a quantity of hot water run through it, hang it up lengthwise to drip till perfectly dry.

When used for more than one person the tube should always be boiled for five minutes after use.

Vaginal Douches

Douches are given, as a rule, either for cleanliness or to relieve inflammation. When used for the former purpose the solution should be of a temperature ranging from 100° F. to 110° F. When given to relieve inflammation it is generally required very hot even 118° or 120° F., and great care must then be taken not to burn the patient by having it any hotter; mix the water well before you test it. Some disinfectant is often added, carbolic or bichloride being the ones most frequently used; they should, however, never be used without a doctor's order. In giving, the patient lies on her back, have the douche pan placed under her properly so that the return flow of the water will run into it. Put a pillow under the small of the back. Before inserting the nozzle let the water flow through

the tube, to expel the air. Insert gently and move it around while in.

The douche nozzle should always be boiled or washed in boric acid, or other disinfectant, after use. Glass douche nozzles are preferable to any other. They can be attached to the ordinary fountain syringe.

Catheterization

Catheterization improperly performed is fraught with so much danger to the patient that it must not be

GLASS CATHETER

attempted till further instruction than can be given in writing is obtained.

Catheterization is necessary when the patient is unable to void urine naturally, but there are many simple devices which should all be tried before this is resorted to; for instance, put hot water in the bed pan, allow water to run from a faucet within hearing (if this is impossible pour water from one vessel to another), squeeze a sponge dipped in warm water over the lower part of the abdomen, or hot stupes can be applied, and, this failing, the stupes can be alternated with ice.

In preparing to catheterize it is necessary to exercise not only the greatest cleanliness but asepsis. The catheter (glass ones are preferable for women) should be boiled for five minutes. Have at hand some small sterile swabs (see chapter on asepsis) in a solution of boric acid. Put the patient on the bed pan (leaving it further in front than for ordinary use), have the patient's knees flexed and separated, drape a sheet around her legs, leaving the vulva exposed. Then wash the hands well with soap and hot water, soaking them afterwards in a solution of bichloride of mercury, 1-1000. With the left hand separate the labia, and carefully wash all around the meatus (the opening to the urethra, the tube leading to the bladder); into this opening the catheter is then carefully introduced, it must not be forced forward if any obstruction is met with, but withdrawn slightly and the course changed.

Care to be Taken

When the bladder is very much distended it should not be emptied entirely at one time; when a pint or a pint and a half has been withdrawn remove the catheter and insert it again four or five hours later.

Before removing the catheter, the index finger is placed over the end; this prevents drops of urine falling upon the bed.

POULTICES AND FOMENTATIONS

Poultices and fomentations are applied for the relief of localized pain, when caused by inflammation. The heat, by dilating the superficial blood vessels, draws the blood from the congested area.

Linseed Poultice

The linseed poultice is the one most generally used. To make it, stir the meal slowly and evenly into water while it is boiling. When it is thick enough not to run, boil it a minute more; remove from the fire and beat it briskly. When properly made it is perfectly smooth, and just stiff enough to drop away from the spoon. Spread it on a piece of muslin the required size and shape, leaving an inch margin all round to turn over. The side which is to go next to the patient is best covered with cheesecloth or gauze. This is cut slightly larger than the muslin, so as to turn back over it to keep the contents of the poultice in place.

Applying

Few poultices should be more than half an inch thick. They should always be applied as hot as the patient can possibly stand them. To keep the poultice warm while taking it to the bedside it can be placed between two hot plates or rolled in a piece of hot flannel. The flannel can be left over it when applied if there is no oil muslin or oil paper to be obtained; these latter are preferable, however, as they are very light and keep in the heat and moisture better.

The poultice is kept in place by a bandage. A muslin binder is the best means for keeping a chest poultice in place. Poultices should always be shaped to fit the

affected part. They should be changed at least every two hours.

Starch Poultice

Starch poultices are used in certain skin diseases. The starch is mixed with a little cold water, then enough boiling water added to make a thick paste. It is boiled, spread and applied in the same manner as the flaxseed.

The cotton jacket or "dry poultice" is made by tacking a layer of non-absorbent cotton or wadding between two pieces of cheesecloth, shaped for the chest, and is excellent to keep on for a few days after other poultices have been discontinued.

Sinapisms

Sinapisms relieve pain through the agency of the mustard which, by irritating the sensory nerves, causes the dilatation of the superficial blood vessels—under the point of application—and the consequent lessening of the congestion in the inflamed tissue. Sinapisms are made of flour, mustard, and tepid water, in varying proportions. Those for a man are generally made one part mustard to four of flour; for a woman one part mustard to six of flour; for a child one part mustard to ten of flour. The water used should always be tepid; cold water feels uncomfortable to the patient, while hot destroys the virtue of the mustard. The flour and mustard are first mixed well together, care being taken to crush all lumps of mustard; enough water is then slowly added to make a thick paste, which is spread on muslin and covered with gauze. The sinapism is generally left on from fifteen to

twenty minutes, but it must be watched carefully, and removed as soon as the surface of the skin is well reddened, as otherwise it will blister. After the removal of the sinapism the skin must be washed, and if a little vaseline be rubbed on, this will allay the irritation.

Fomentations

The usual method of applying fomentations is to have two pieces of flannel in use, applying them alternately and changing every three minutes for twenty minutes. The easiest way is to have the water boiling over an alcohol or gas lamp near the bedside.

Put two layers of coarse, soft flannel (an old blanket is good) in the center of a towel; dip this into BOILING water, wring it out by twisting the ends of the towel, give the flannel a quick shake, and apply the flannel; cover with oiled muslin or oiled paper.

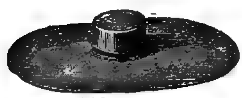
As hot applications promote suppuration there are conditions when their use is contra-indicated and cold applications are ordered.

Cold Applications

The most effectual way of applying continuous cold is by means of the ice cap. The pieces of ice put into the cap should be about the size of a walnut; it should never be more than half filled, and the air should be expelled before putting on the cover. Salt is sometimes mixed with the ice to intensify the cold. The cap should be tied in an old handkerchief or piece of gauze to prevent the rubber from coming next the skin, as the extreme cold is very irritating, and may even produce frost bites.

Ice Caps

When ice caps are being used all the ice must not be allowed to melt before the cap is refilled, as the reaction caused by the resulting change of temperature is very injurious, especially if there is any inflammation.



ICE CAPS

Compresses

For the application of cold to the head, old handkerchiefs or pieces of soft gauze can be used, folded so that they will come down well over the temples, but not touch the pillow. They must not be wide enough to wet the hair, or come far down over the eyes. Compresses should not be made too wet. The best scheme is to have a piece of ice in a basin, and two compresses, then while one is on the forehead the other can remain rolled round the ice.

Compresses for the eye should be small and very light. If both eyes need the compresses two separate ones should be used. If only one eye is affected be careful that the compress on it does not touch the other, lest it should become infected. If gauze is used for compresses always turn the ends in, that the ravellings may not annoy the patient.

TEST QUESTIONS

The following questions constitute the "written recitation" which the regular members of the A. S. H. E. answer in writing and send in for the correction and comment of the instructor. They are intended to emphasize and fix in the memory the most important points in the lesson.

HOME CARE OF THE SICK.

PART I.

Read Carefully. Place your name and address on the first sheet of the test. Use a light grade of paper and write on one side of the sheet only. *Do not copy answers from the lesson paper.* Use your own words, so that your instructor may know that you understand the subject. *Carry out the directions given in the text, if possible, before answering the questions.*

---

1. What is expected of the nurse?
2. Give the period of incubation, first symptoms, and time required for isolation for: (a) Mumps, (b) Measles, (c) Smallpox, (d) Scarlet fever, (e) Diphtheria.
3. What are the causes of cholera infantum? Symptoms? What are the symptoms of intestinal obstruction?
4. What are the most common causes of convulsions in children? What should be done?
5. What are the primary symptoms of typhoid fever? Of pneumonia? Of meningitis?
6. What is the difference between false croup and true croup in symptoms, danger, and treatment?
7. Describe the ideal sick room.
8. How should the sweeping and dusting be done? How prepare for the night?
9. Why is ventilation in the sick room important? Describe different methods.
10. Make the bed as explained in the lesson and then describe the process.

11. Endeavor to change the bedclothes with a person in bed and report your success.
12. The points suggested in the section on the "Care of the Patient" are all essential. What ones might you neglect if you had no experience?
13. What must be guarded against in lifting and moving a helpless patient?
14. How would you change a patient from one bed to another?
15. What are bed sores and how can they be guarded against?
16. How would you wash the hair?
17. Describe the process of giving a bath in bed.
18. How can the heat of the blood be found? Why is it important?
19. How would you count the pulse?
20. Mention some of the points in a patient's condition that should be noted and recorded?
21. What rules should be observed in giving medicines?
22. What are the different kinds of enemata? How given?
23. What devices can be tried before catheterization is attempted?
24. How is a linseed poultice made and applied?
25. What is a sinapism? A fomentation?
26. How is cold applied to relieve pain?
27. Do you understand everything in this lesson? What questions occur to you?

NOTE.—After completing the test sign your full name.

LOUIS PASTEUR, FATHER OF BACTERIOLOGY

HOME CARE OF THE SICK

PART II

CONTAGION; DISINFECTION—NURSING IN CONTAGIOUS DISEASES

We have learned in our study of Household Bacteriology that nearly all diseases, especially those coming under the head of infectious and contagious, are caused by certain species of bacteria.

If we would be immune from these diseases, then we must do everything in our power to exclude these germs. Cleanliness, plenty of sunlight and fresh air, are the first requisites for their exclusion; and, when disease has entered, proper isolation and disinfection to prevent their spread.

Disinfection

By disinfection we mean destruction of the bacteria by use of certain chemicals or heat. Heat, when it can be used, is always the surest and quickest method. The rules for disinfection, or sterilizing by heat, will be given under the head of "Surgical Operations at Home."

The disinfectants most commonly used in illness are bichloride of mercury, 1-1000, for the hands and utensils, and carbolic acid, 1-20, for the clothes, instruments, etc. Bichloride is the stronger disinfectant, but as it discolors clothes and instruments it should not be used for them.

MAKING DISINFECTANT SOLUTIONS

Bichloride of Mercury

A bottle of blue bichloride tablets can be bought at any chemist's; this is the safest form to use it in the home, as the tablets make a blue solution. The bichloride is perfectly odorless, and if the clear, uncolored solution were used it might be mistaken for water. As this is a very strong poison the tablets should be kept always under lock and key, and out of the reach of children. It is well to have a bottle of tablets in the house at all times, to use in case of cuts, etc. They contain salt, which is always required in making bichloride solution.

To make bichloride solution dissolve one tablet in a quart of hot water.

Carbolic Acid

When a large quantity of carbolic acid solution will be required continually, it is cheaper to buy the 95 per cent solution, which can be reduced as needed to the required strength. To make five pints of 1-20, mix four ounces of the 95 per cent carbolic with five pints of boiling water and shake the bottle well.

As 95 per cent carbolic is not only a strong poison, but also very corrosive to the skin, so be careful not to spill even a drop on your hands, but if you should, wash the spot immediately with alcohol or warm water and soap.

Infection and Contagion

An infectious disease is not always a contagious one; that is, it cannot be contracted by being in the same room with the patient, but it is transmittable by some intermediate means of communication.

Tuberculosis is not contracted by coming in contact with a patient suffering from that disease, but by inhaling dust containing the germs derived from the dried sputa of some consumptive person.

The germs of typhoid fever are disseminated when the stools and other excreta of the patient are not properly disinfected by those in charge.

Disinfection Without Isolation

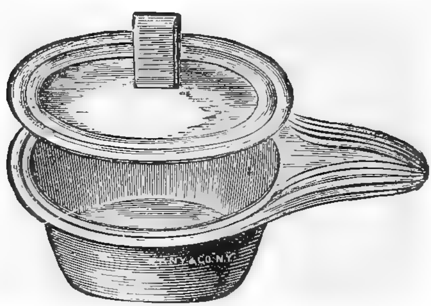
It is not necessary to isolate patients suffering from diseases of this kind, but it *is* necessary to disinfect, according to the nature of the infection; thus, knowing that the germ of typhoid fever is in the stools, and to some extent in the urine, the stools and urine must always be disinfected by covering with bichloride, 1-1000, and letting stand half an hour before emptying. The bed pan must be well washed and disinfected afterward. It is also a wise precaution to disinfect the bed-clothes by soaking in carbolic, 1-20, for twelve hours, and then boiling; also to keep utensils and dishes used for the patient separate, boiling them before they are again mixed with the household supply.

Consumption

Consumption, or tuberculosis of the lungs, is perhaps the most dreaded disease of the present day. There are more deaths from it than from any other, except in times of epidemic. The sputum of patients suffering from this disease contains many millions of the bacilli. If this is deposited in places where it is allowed to dry and become pulverized, it is a source of danger to others. The sputum must, therefore, be disinfected.

Patients suffering from this disease should be provided with sanitary cups. The best for this purpose are made of prepared paper and are very cheap. These should be burnt after being in use for twelve hours at most. If these cannot be obtained, porcelain ones with covers may be used, but bichloride or carbolic must always remain in the cup, and it should be emptied and scalded frequently. The patient should not use ordinary handkerchiefs, but gauze or Japanese paper, which should be burnt. All clothing

Sanitary Cup.



Paper Sanitary Cup.

and bedding soiled by the sputa should be disinfected in the usual manner, and the sufferer should wash and disinfect the hands frequently.

Perfect cleanliness, plenty of sunlight and fresh

air, and nourishing food are the most important points in the modern treatment of consumption. Special care should be taken by consumptives to smother every cough when close to other people.

CONTAGIOUS DISEASES

Measles, scarlet fever, smallpox and diphtheria are not only infectious but also contagious, and can be taken by touching the person or anything that has come in contact with the patient.

The Spreading of Germs

Anyone who has been in the room with a patient suffering from any one of these diseases can scatter the germs far and wide; this must be remembered, especially by those who do the nursing. It is an absolute necessity for them to go out every day, but before doing so they should change all their clothes, and wash face and hands with bichloride, 1-1000. As it would be impossible to wash the hair every time, it should be covered by a cap, while on duty. Even when all these precautions have been taken, shops, theaters, and street cars should be avoided.

The rules of isolation are these:

Rules of Isolation

(1) The patient should be removed to a room as remote as possible from the rest of the house.

(2) No one should be allowed to enter the room except the physicians and attendants.

(3) Long-sleeved aprons and caps which will cover the hair should be worn by physicians and attendants while in the room. (These can be made of cheap muslin.)

(4) A solution of bichloride, 1-1000, should be kept by the wash basin for the disinfection of hands, and they should be disinfected every time after touching or doing anything for the patient. For proper isolation there should be two rooms,—the wash stand, gowns, disinfectants, etc., being kept in the outer room.

Disinfection of Clothes

(5) A foot tub or other receptacle containing carbolic, 1-20, should be placed near the bedside when the clothes are about to be changed, and they should be put immediately into this, remaining there well covered for twenty-four hours. They should, even then, be boiled before being washed.

(6) The advice given earlier as to the furnishing and care of the sick-room is especially applicable in cases of contagious diseases. When dusting, the duster should be dampened in 1-40 carbolic. As bare floors are apt to be noisy, a small rug or two may be retained, but they should be old ones, as they ought to be burned at the termination of the disease. They must not be shaken, as at other times, but kept well dusted with the damp duster.

(7) It is well to keep sheets, wrung out in carbolic, 1-20, both between the two rooms set apart for the nursing and at the entrance of the outer room. The door of the latter must be kept closed.

Dishes and Utensils

(8) The dishes and utensils used by the patient and attendants must not be removed from the room; they must be washed there, the patient's always being

washed and kept separate. When food is brought it should be left at the door of the outer room. The attendant, first taking off her cap and apron and disinfecting her hands, should remove the food from those dishes to the ones she has in the room; the others should be removed immediately.

Separate Bath Room

(9) Whenever it can be managed the isolated rooms should be in close connection with a bath-room, which should be set apart for the use of the inmates of the sick-room. When this is impossible the attendant must, when it is necessary to go there, first remove her cap and apron and disinfect her hands. When her object is to empty the slop jar or bed pan they should be completely covered with a large towel wrung out in carbolic.

(10) The bed pan should always have bichloride, 1-1000, in the bottom, and after use more of the same solution should be added. It should stand thus for half an hour before being emptied. When there is no separate bath-room a tightly covered box nailed on the outside window sill of the outer room will be found convenient to hold the bed pan, while its contents are being disinfected.

Special Rules

Besides the general rules for disinfection there are in some contagious diseases special rules, incidental to the nature of the disease.

In scarlet fever the greatest danger of infection lies in the dissemination of the skin, while it is peeling. To prevent this the patient should be rubbed all over,

night and morning, with carbolized vaseline or boric ointment.

In diphtheria the most virulent contagion is in the expectoration, especially when the membrane loosens. Soft gauze should be used instead of handkerchiefs, and if there is no grate in the room a pan must be at hand, in which these can be burnt immediately after use.

DISINFECTION AT THE TERMINATION OF THE DISEASE

Time of Quarantine

Even after the fever has abated it is necessary to keep the patient isolated, or "in quarantine," as it is called, for some days. A rough estimate of the time required for quarantine in the different diseases is given in the table in the first section, but the doctor should always be the one to decide when it may be raised, as circumstances or complications may arise which might make it allowable to shorten or necessary to lengthen the time.

Disinfecting the Patient

When the doctor does allow the patient to be moved, a warm cleansing bath (including the washing of the hair) must be given. This is followed by a bichloride bath, 1-1000, and an alcohol rub. The patient is then wrapped in a clean sheet and taken to a different room, where fresh clothes which have not been in the sick-room are put on. Those who have done the nursing must go through the same procedure.

THE DISINFECTION OF THE ROOM AND ITS CONTENTS

Disinfecting with Formaldehyde

The use of sulphur fumes as a disinfectant has been proved to be practically useless, and formaldehyde has almost entirely replaced it. The easiest form of using this is the "Pure Formaldehyde Gas" put up by Seabury & Johnson. It can be procured at most druggists. In appearance it looks like a stone, cone shaped. There are two sizes; the smaller, 2 inches square, will disinfect a room 500 cubic feet, and the larger one, 1000 to 1500 cubic feet. Close the windows, pasting paper over all the cracks; pull down the blinds; open cupboards, drawers, bundles, etc., that everything may be exposed to the fumes of the gas; place the fumigator on the top of an inverted pail—it must not be too near the floor, or it may scorch it—set fire to the top of it, and leave the room; lock the door and paste up the cracks and key hole.

Leave the room thus for five or six hours, then open all the windows, if possible allowing them to remain open for twelve hours.

Books and toys used in the sick-room should be burned, as they are hard to disinfect.

The Mattress

Unless the mattress can be baked it should be opened, so that the formaldehyde can penetrate through to its center. In all large cities there are bake houses where such things may be sent for disinfection at comparatively small cost. They should be carefully wrapped up.

PERSONAL PRECAUTIONS TO BE TAKEN BY THOSE NURSING CONTAGIOUS DISEASES

(1) Take sufficient sleep and rest; never in the patient's room. It is when the muscles are relaxed, as they are when resting, that the greatest danger of infection comes.

(2) A daily walk in the fresh air is necessary.

(3) A daily bath; change of all clothing at least three times a week. The clothing must be disinfected.

(4) When working over the patient never stoop so that you inhale her breath. Never kiss your patient.

Personal Disinfection

(5) Never put your hands to your face, especially your mouth or eyes, without first disinfecting them.

(6) Disinfect your hands frequently in bichloride of mercury, 1-1000. Keep the nails short and scrupulously clean. When washing the hands wash the soap off before putting them into bichloride, or they will soon become sore.

(7) Before meals wash and disinfect your hands well, rinse your mouth with boric acid solution or listerine. Never eat in the patient's room.

(8) When irrigating a diphtheria patient's throat tie a handkerchief over your mouth, and wear glasses to protect the eyes.

The nursing in infectious and contagious diseases is the same as in all other cases of fever. While the temperature is high the patient should be kept in the recumbent position to avoid strain upon the heart.

In typhoid this position is particularly necessary, as hemorrhage from the intestines is liable to occur if it is not strictly adhered to.

Nourishment and medication must be given exactly as ordered. When the doctor orders fluids give nothing solid; many a life, especially after typhoid, has been lost by so doing. **Nourishment**

Except when the patient is nauseated, unless contrary to orders, give plenty of water, every two hours at least. See that the patient drinks it slowly.

Remember the rules already given about the care of the mouth, especially with typhoid patients. Vaseline applied to parched lips gives relief.

In measles and scarlet fever the eyes are apt to be affected, so the room should be kept darker than in other cases, and the eyes should be washed with boric acid, always bathing from the inner angle outward. **Care of the Eyes**

In all diseases where the skin is not working properly, as in measles, scarlet and other eruptive fevers, be especially observant of the urine as various kidney complications are liable to ensue.

There is little danger of the patient catching cold while the temperature is high, but when it begins to lower be doubly careful.

SURGICAL OPERATIONS AT HOME *

For twenty-four hours previous to operation the patient should be given broths every two hours, but neither milk nor solid food. A cathartic is given, if possible, thirty hours prior to operation, and repeated

*This section is optional.

in six hours; a soap suds enema is given three hours after the first cathartic, and repeated twelve hours before operation. A bath is also given the afternoon before, and after the bath the field of operation is shaved, then thoroughly cleansed with green soap, and a compress wet with green soap solution, 25 per cent to 50 per cent, applied (the liquid green soap which is used for this purpose can be obtained at any druggist's); this is covered with a protector—oil muslin or oil paper—and left on from three to six hours, as the skin will bear. When removed, the surface is washed in the following order, with green soap, ether, alcohol, and solution bichloride of mercury, 1-1000; a compress wet in the latter is applied covered with a protector, and left on till an hour before operation, when the process is repeated and the fresh bichloride compress is left on till the doctor removes it on the operating table, after the patient is under the influence of the anaesthetic; then he re-scrubs it, and the ether, alcohol, and bichloride must be ready for him to use. All these precautions are taken to kill or remove *every* bacterium or spore.

Preparation for an Operation

For a vaginal operation the rules for diet, catharsis, enemata and bathing are the same as for any other. In addition a green soap douche is given on the preceding day, followed by one of bichloride of mercury, 1-5000. The vulva is then covered with a pad wet in solution of bichloride of mercury, 1-1000, until two hours before operation, when another bichloride douche

is given, the parts cleansed and a fresh bichloride pad applied.

Just before the anaesthetic is given, the patient should void urine. If she has false teeth they should be removed.

The Room

The Room. In the choice of the room the light is one of the first considerations, a good light being a positive necessity. If possible the operation should take place in a different room from the one the patient is occupying beforehand. Remove rugs, carpets, all unnecessary furniture, curtains and draperies. A piece of cheesecloth tacked across the lower sash of the windows will keep the light from being too glaring and obstruct the view from outside.

The day before the operation the walls should be dusted, especially the cornices and mouldings; the floor should be scrubbed if possible, or at least wiped with a damp cloth and it should be washed over again the morning of operation after the furniture is in place.

If the patient is to remain in the room after the operation, have the bed as nearly in the position it is to occupy later as possible, but out of the way.

Protect the floor under and around the operating table with several thicknesses of paper, covered with a sheet tacked down at the corners.

Operating Table

A kitchen table covered with a couple of old blankets protected by a rubber pinned or tacked under the table will answer for the operating table. Three small

tables should be at hand, protected with papers, covered with large sterile towels. On one table, convenient to his right hand, the surgeon will need his instruments. On the second table have three bowls which have been well washed first with soap and hot water, then bichloride, 1-1000. The inside of the bowls should not be dried. One bowl is intended to hold the solution for the disinfection of the surgeon's and his assistant's hands, the other two for washing the sponges. The third table is required for the dressings and sterile towels. The former, the doctor will provide or tell you where to get them. Very reliable sterile dressings are now put up by Ellwood Lee, and can be procured at any drug store. They are really better than anything that can be prepared without a sterilizer. If it is impossible to obtain these, the dressings should be prepared in the same manner as the towels, namely, rolled in bundles not more than 9 inches square (or the heat will not penetrate) and steamed in the clothes boiler for at least one hour. If there is no tray to keep them out of the water a hammock of gauze will answer the purpose. They are then dried in the oven, which must not be hot enough to scorch them.

Sterile Dressings

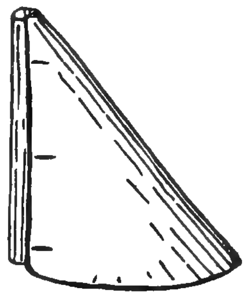
At least a dozen and a half towels will be required. The surgeon will bring the instruments and anaesthetic. If chloroform is administered, some vaseline will be required to grease the patient's face.

An ether cone can be made out of paper, covered with a towel.

An irrigator or douche bag must be at hand for the irrigation. This should be sterilized by boiling for five minutes, as are also the surgical instruments.

Sterilized Water

There must be plenty of sterilized water prepared, six gallons at least, two gallons of which must be boiled long enough beforehand to be cold. This must be kept tightly covered after it is boiled, or it will not remain sterile. Water must boil at least thirty minutes to be properly sterilized.



Ether Cone, made from stiff paper, covered with a towel.

Bichloride, carbolic and salt solutions may be needed and must be at hand, as well as two sterile pitchers, a pus basin, a chair, a blanket or two to cover the patient, two rubbers to protect the blanket, a slop jar, hypodermic syringe, and stimulants—the doctor will give definite instructions regarding the last.

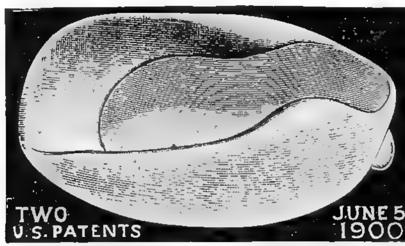
The Bed

The bed is made according to the directions already given for bedmaking, with the exception that no pillow will be required as the patient's head must be kept low. Instead, a small rubber covered by a towel is desirable to protect the bed if the patient is nauseated. A blanket is put over the patient, before the upper sheet; hot water bottles should be in the bed all the time she

is on the table; a couple of towels and pus basin should be on a table near the bed in case of nausea, also small pieces of gauze to wipe the mucus out of the mouth, and a wedge-shaped piece of wood to put between the teeth if they become clenched.

Sterilizing the Hands

If necessary to assist the surgeon during the operation, scrub the hands for ten minutes with hot water and soap, using a new stiff nail brush which has been



PORCELAIN BED PAN

soaked in carbolic, 1-20. Be particularly careful of the finger nails, which should be cut very short. After scrubbing, the hands should be soaked in bichloride, 1-1000.

Nobody, whose hands have not been so treated, must touch the dressings or instruments, and after washing nothing but the sterile things must be touched.

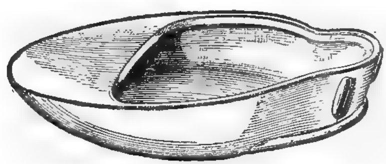
After the Operation

When the operation is over, if the patient's nightgown is wet it must be changed. She is then covered with a warmed blanket, and put into bed. She should lie on her back without pillows and be kept very quiet.

If she vomits, hold her head on one side to prevent strangulation.

Washing the mouth out, as previously directed, will help to relieve the thirst which is generally intense after an anaesthetic.

After a few hours either crushed ice or very hot water, in teaspoon doses, may be given.



Bed Pan, "Eureka" Pattern

The Pulse

The pulse must be watched carefully, and if its rate increases should be reported to the doctor, as this, together with pallor, restlessness, longing for fresh air, sighing respiration, and fall of temperature is a sign of hemorrhage. As the hemorrhage does not always show through the dressing these signs must be watched for.

Perfect Cleanliness

For treatment of hemorrhage see the section on "Emergencies." As the after treatment depends altogether on the nature of the operation, and subsequent condition of the patient, no rules for it can be given here further than to emphasize the fact that the first requisite for success in surgical work is perfect cleanliness. The gauze used for dressing the wound after the operation, the instruments and the hands of those

touching these things, must always be as carefully sterilized for the dressing as for the operation.

The diet, like the treatment, will depend upon circumstances. For the first day or two the patient is generally on fluid diet, and care must be taken that it is given slowly and in small quantities, but as soon as possible plenty of nourishing food should be given to build up the system.

OBSTETRICS

The average duration of pregnancy is 280 days. The most accurate way of calculating the probable date of confinement is by counting back three months from the date of the cessation of the last menses and adding seven days.

Preliminary Care

The expectant mother should place herself under the doctor's care in the early stages of pregnancy, as not only her own but the infant's after health depends largely on the care the mother takes of herself at this time. The principal rules of hygiene to be followed are:

1. Daily exercise in the open air.
2. At least eight hours' sleep out of twenty-four.
3. A daily bath, a sponge bath if the tub bath is too exhausting. A brisk rub after the bath will cause a good reaction.
4. The bowels should be moved daily, with mild cathartics if necessary.

5. The urine must be carefully watched and any abnormality reported to the doctor. Frequent specimens should also be sent him, as there may be danger of serious kidney troubles.

6. Freedom from excitement, worry, hurry, and too heavy manual labor.

7. The clothing should be worn loose enough to allow of free circulation.

8. A nourishing, but not too stimulating diet should be adhered to.

9. The nipples require attention, especially during the last two months, and should be washed twice daily with boric acid solution and treated with fresh cocoa butter or albolene.

What to provide: **For the Mother**

1. Two large rubber sheets.

2. If possible, a Kelly Pad, if not, make an obstetrical pad, consisting of four thicknesses of cotton wadding, covered with a layer of absorbent cotton, the whole encased in absorbent gauze and tacked to keep the cotton in place. This pad should be three-quarters of a yard square.

3. Two dozen pads for dressings, half a yard long, ten inches wide and two inches thick, made of the same materials.

4. Two dozen smaller pads.

5. Five boxes of sterile gauze (each containing one yard of gauze), to be used both for the mother's dressing and to cover the baby's cord.

6. One roll of adhesive plaster.

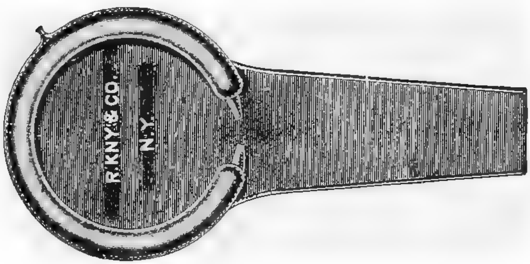
7. Six abdominal binders of unbleached muslin.

8. Six breast binders of unbleached muslin.

9. One pair long stockings made of flannel or an old blanket.

10. Two dozen paper bags in which soiled dressings can be put and burnt.

11. At least two hot water bottles.



KELLEY PAD.

12. Bed pan—"Perfection" is the best.

13. Douche pan.

14. Douche can or new fountain syringe bag.

15. Two glass douche nozzles.

16. Two glass catheters.

17. One agate basin to boil nozzles and catheters in.

18. Two large agate pitchers in which water can be sterilized, solutions made, etc.

19. Clinical, room, and bath thermometers.

20. One bottle carbolic, 4 per cent.

21. One bottle Lysol.

22. One bottle bichloride tablets.

23. New nail brush and fresh cake of soap for the doctor's use.

For the baby:

For the Baby

1. A tube of sterile tape.

2. A rubber sheet, or, preferably, a nursery cloth to protect the crib mattress.

3. Talcum powder.

4. Sweet oil or sterile vaseline.

5. Pure castile soap (never use perfumed soap of any kind).

6. Bath tub—good rubber ones are the best.

7. Old table linen makes excellent towels and wash cloths for the baby.

8. A large square of soft, thick flannel to roll baby in after it is greased.

9. Basket containing sewing materials and safety pins.

10. Crib and bedding.

11. Scales to weigh the baby in are very desirable.

12. A rubber or padded lap protector for the attendant to use while bathing the baby.

13. A large flannel apron for the same purpose. The latter is especially desirable as the baby can be rolled in it, when taken from the bath.

Clothing for Baby

14. Baby's clothing: Six flannel bands, not hemmed, 6 inches wide, three-quarters of a yard long. Four knitted or woven shirts. Six flannel petticoats. Six white petticoats; these should all be made without

bands, and the fastening on the shoulders, running a draw tape through the hem of the flannel petticoat, will keep the baby's feet warm without confining them. Six slips for night wear. Six dresses. Diapers, two sizes, eighteen and twenty-two inches square.

As in other cases of sickness, the room should be as large, light, and airy as possible, scrupulously clean, and have no superfluous furniture.

The Bed

In this instance the foot of the bed should be towards the light. It should be made as shown in the section on bed-making, with the addition of a second rubber covered with a clean sheet, and either a rubber Kelly pad or an obstetrical pad (made as already described).

The furniture and floor should be protected in the same manner as they are for operations.

Besides the bed a table for the doctor, wash stand, nurse's table, extra table or bureau and chair will be required. See that there is a hook on which to hang the douche bag.

On the wash stand have hot and cold water, soap, nail brush, scissors, and nail cleaner, towels, and bowl of bichloride, 1-1000.

Doctor's Table

On the doctor's table, bowl of bichloride, 1-3000, with towels and sponges in it; bowl of lysol, sterile towels, sterile douche tip, also rubber and glass catheter.

Nurse's Table

On the nurse's table have (for baby) sterile scissors and tape wipes in boric acid (these consist of

small squares of gauze), two large squares of gauze to put over the baby's mouth if necessary to blow into it, soft flannel square to wrap baby in, dressing for cord as ordered by the doctor.

For the mother—chloroform, mask, pus basin, sterile dressing and pads. Under the table the douche pan (which has been washed in bichloride and kept covered with towel, wrung out in same), slop pail and basin, paper bags for soiled dressings and placenta, foot tub, hot and cold water.

On the bureau—room, bath and clinical thermometers; salt, vinegar, alcohol, whisky, hypodermic syringe, binders, pins, hot water bag, tray and alcohol lamp.

First Signs

The signs of beginning labor are pains in the lower part of the abdomen and back, occurring at regular intervals, about once every half hour, and a discharge of mucus tinged with blood from the vagina.

True pains can be distinguished from false by placing the hand over the lower part of the abdomen; in true pains the contractions of the uterus are to be readily felt through the abdominal wall. As the labor advances the pains grow more severe and the intervals shorter. The first stage of labor consists in the dilation of the uterus, and ends when the membranes have ruptured and the uterus is completely dilated.

The second stage or stage of expulsion ends when the child is born.

The third stage ends when the placenta is expressed and the uterus contracted to the size of a closed hand.

At the beginning of the first stage, the patient should have a bath, and her hair braided in two braids. Her bowels are emptied by the giving of a soap suds enema. After this the external parts are washed with bichloride solution, 1-5000, and a pad wet with bichloride solution, 1-10000, or boric acid applied. She is as a rule allowed to walk around the room during the first stage, which may last from ten to twelve hours, and even longer.

She is best clad at this time in a night gown, warm wrapper, and long stockings made of flannel or an old blanket, coming well up over the thigh.

Milk and broths should be given every two hours; alcohol and other stimulants must be withheld.

The patient must be instructed not to bear down during the pains of this stage, and to sit or lie down when a pain occurs.

The Second Stage

During the second stage the patient must be kept strictly in bed. The wrapper is removed and a short dressing sack put on in its place, the night gown is tied up under the arms, and with it a sheet, the end of which comes down over the legs covering the blanket stockings, which are left on; it can be folded up in the center when necessary.

The patient usually lies on her back. A strong band of muslin around the foot of the bed, with the ends so that she can hold them to pull on, will help the patient during pains.

The attendant's hands must be well scrubbed and disinfected with bichloride, 1-1000, that she may be ready to help the doctor.

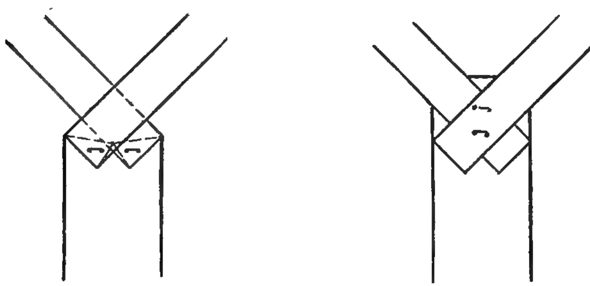
If the doctor does not arrive in time, the attendant, taking all antiseptic precautions, must place her hand against the head as soon as it appears and hold it back during the pains, thus preventing too rapid descent. When the head is delivered insert the finger into the passage to see if the cord be around the neck, if so, pull it carefully over the head. The right hand supports the child as it comes, and the other is placed on the abdomen and pressed firmly but gently downward till the child is expelled. One hand must be held over the uterus from this time until at least half an hour after the placenta is expelled.

Care of the Child

Place the child on its right side between the mother's thighs, wipe out its eyes and mouth with swabs wet in boric acid; place gauze over the mouth and blow into it; if it does not cry, slap it on the back and chest; if the color does not improve the cord will have to be tied and cut immediately (it is generally better to wait five minutes before doing this) and the child plunged into a hot bath. It is rarely necessary to do this, however. The cord should be tied tightly with the sterile tape about an inch and a half from the navel, and again an inch further on; it is then cut (with sterile scissors) between the two knots. The baby is rubbed with vaseline or olive oil, rolled in the flannel square, and a warmed blanket, then put in its crib with at least

one hot water bottle until the mother is attended to.

The Third Stage The placenta is generally expressed about fifteen or twenty minutes after the birth of the child; but even if it take longer, the cord should not be pulled upon—it is better to gently manipulate the abdomen above the uterus, and continue doing this very gently with one hand as the placenta comes out, while with the other hand twist slowly to aid its coming. Even after



ENDS OF THE Y BREAST BINDER

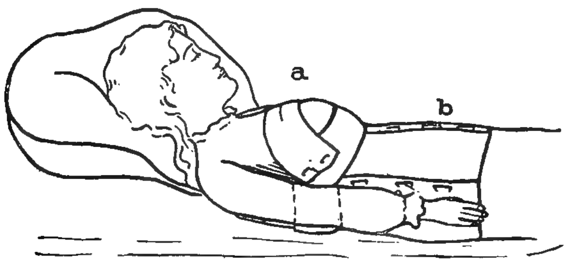
the placenta is expressed, the hand must remain pressed downward over the uterus until it feels hard and firm. An assistant can in the meantime be washing the patient with bichloride, 1-2000, and removing the soiled linen. When the uterus is firm and hard a binder should be applied, a dressing of sterile gauze and a pad being first placed over the vulva; this is afterward pinned on to the binder to keep it in place.

The Binder The binder is best made of unbleached muslin. One for a medium size woman should be a yard and a

quarter long and half a yard wide. It should, when pinned in place, extend from the border of the ribs to below the prominence of the hips, and should be made to fit the contour of the body by taking in darts over the hips on the upper and lower edges.

Y Breast Binder

A binder is also used to make compression upon the breasts. There are a variety of these, but the Y



Y BREAST BINDER (*a*) AND ABDOMINAL BINDER (*b*) IN PLACE

breast binder originally used in the Boston Lying-in Hospital is perhaps the easiest one to manage, and has the advantage of leaving the nipples exposed. A bandage shaped like a T is made by folding muslin lengthwise and pinning it at right angles to another strip folded in the same way. The T is then made into a Y by making a diagonal fold in the middle of the cross piece and fastening the middle of the plait with safety pins.

To apply, dust the surface of breasts with powder, draw base of Y beneath the patient's back until apex

of the fork is external to the outer edge of breast. Lift breasts upward and toward each other. Draw lower arm of fork snugly across chest beneath breasts, the inferior border of this arm extending at least one inch below margin of breasts; the end of arm is pinned to end of strap, which has been passed beneath back; the lower border is pinned in the center to abdominal binder. The upper arm of fork is then drawn across chest above the breasts and pinned like the lower to the main strap.

Hemorrhage

Watch for the signs of hemorrhage already described. Should hemorrhage occur send for the doctor immediately; induce contractions of the uterus by grasping the fundus and employing a firm but gentle kneading (no doctor would leave the case in your charge without showing you exactly how to do this). Elevate the foot of the bed, and give a hot douche of sterile water, 120° F. Sometimes astringents such as vinegar are added to the douche, but unless the case is very urgent it is best not to use it without the doctor's order.

The patient must be kept quiet and on her back for the first six or seven hours, afterward she can turn on her side but should not sit up for at least five days. She is generally allowed to sit up on fourteenth day, if all discharge has ceased. In no case should the usual routine of life be resumed under four weeks.

The diet is usually liquid for the first twenty-four hours, after which all symptoms being normal, the patient is allowed almost any easily digested food.

The dressing and pad should be changed every two hours until the discharge diminishes, later every three to five, as the case demands. After the third day it is usually necessary to change it only after it has been removed for the requirements of the patient. These dressings must all be sterile and the hands disinfected before applying them. If douches are ordered, boil the douche nozzle for five minutes before and after use.

The breasts must be washed with boric acid solution before and after nursing.

THE CARE OF THE CHILD

After its birth the child's eyes and mouth are cleansed with 2 per cent boric acid solution and its whole body greased with sweet oil or sterilized vaseline. It is then wrapped in warm flannel, put in a crib or basket, heated with hot water bags if necessary, and covered with a warmed blanket. It can then be left until the mother is cared for. Watch the cord carefully as there is danger of hemorrhage.

First Bath

The first bath is often given at once, although some doctors prefer to have the baby rubbed with oil only for the first few days. Before beginning have everything necessary together—a foot tub containing water, 100° F., bath thermometer, warm, soft towels, wash cloth, castile soap, dusting powder, a dressing for the cord, boric acid solution, small squares of gauze, a rubber lap protector, two diapers, flannel band, shirt, flannel petticoat, and a simple, soft white dress.

The head is first washed, using very little soap, rinsed and thoroughly dried; then wash behind the ears, the crevices of the neck, axilla, joints, and between the buttocks and thighs carefully. Only the part being bathed should be exposed. The baby is now put down into the tub and rinsed, supporting the head and back firmly with the left hand and arm. Cover the lap protector with flannel apron or warm towel and when you lift the baby out, roll this around it. Dry by patting; use very little powder and only when it is necessary to prevent chafing. Some doctors consider it better not to put the baby in the tub until after the cord is off.

Navel Dressing

The navel is now dressed by cutting a hole with sterile scissors in a piece of sterile gauze, which is slipped over the cord and folded about it. The cord is laid toward the left side and a pad of sterile absorbent cotton put over it. A soft flannel binder holds the pad in place and must be put on firmly and smoothly, but not too tightly. It is best sewn on with a few large stitches. After the bath the baby should be rolled in warm flannel and laid on its right side in its crib.

Nursing

The Feeding. The first six weeks the baby should nurse every two hours during the day and every three hours at night; afterward this may be changed to every three hours during the day and twice at night. These hours should be rigidly adhered to. If the baby seems thirsty between meals a little plain water may be given.

The baby's mouth should be washed with 2 per cent boric acid solution before and after feeding and also the mother's nipples.

When for any reason it is impossible for the mother to nurse the child, great care must be exercised in the preparation of its food. First the bottle and nipples must be thoroughly cleansed immediately after each feeding by rinsing in cold water, then washing in hot water and soap suds and rinsing in hot water. The bottle is kept turned upside down and the nipples in a 2 per cent solution of boric acid. Both bottle and nipples should be boiled for five minutes twice a day.

Every doctor has his own formula for prepared milk, but whatever the preparation used it is best pasteurized if not above suspicion.

FOOD FOR THE SICK

In many diseases, especially those accompanied by fever, the powers of digestion are much impaired. For this, as well as other reasons, it is necessary that all food given should be in a liquid form. Milk, except under certain conditions, is at such times considered the best food, as it contains in a dilute form all the constituents of the solids, namely: albumen, fat, sugar, the inorganic salts of lime and potash, and water. **Milk**

If curds appear in the stools, or vomiting ensues, it shows that the milk is not being properly digested. This difficulty may often be overcome by diluting it with seltzer or other effervescent water, by the addition of lime water or bicarbonate of soda (ten grains to a pint), or by peptonizing the milk. (The recipe for the latter will be found at the end of the section.)

A good substitute for milk is white of egg, beaten to a froth, diluted with an equal quantity of water, and flavored with lemon juice.

Beef tea and broths contain very little nourishment, and should, therefore, be given only occasionally, for a change.

Amount and Frequency

Patients on fluid diet should, as a rule, be given six ounces every two hours, or half the quantity every hour. Of course there are times—as after operation, or when the patient is nauseated—when less must be given.

When a patient is on liquid diet it is especially imperative to give her nourishment at stated times and regular intervals. In giving see that it is taken very slowly.

Feeding Cups

As a rule, when a patient is sick enough to be on fluid diet it is necessary for her to maintain the recumbent position, even while drinking, and there are several devices to facilitate this. There is the old-fashioned feeder with the spout, but the drinking tube or "ideal glass" are preferable. When raising the head slip the arm under the pillow; take care not to throw the head forward, and by so doing make it difficult to swallow. Never bring a glass to the patient in your hand, but on a small tray or plate, and with it a napkin to fold under the patient's chin and prevent drops soiling the sheet.

When a patient is on milk diet her mouth should be washed out after every feeding, with listerine or boric

acid, otherwise it will soon become coated and sore. Directions for doing this were given in the section on the care of the teeth.

Solid Food

A convalescent patient should be given solid food only by degrees, beginning with the so-called soft diet, which includes broths, strained vegetable soups, soft cooked eggs, milk toast, junkets, custard, jellies, and raw beef sandwiches. Then comes "light diet," which means the addition to the "soft diet" of underdone steak, chops, chicken, baked potatoes, and farinaceous puddings.

Pastry and all rich or highly seasoned food should be avoided until the patient has, in every respect, resumed her usual routine of life.

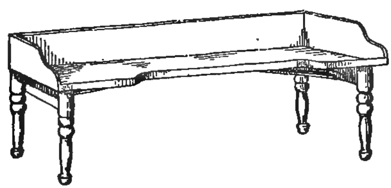
Special Diet

In diseases such as rheumatism, Bright's disease, diabetes, dyspepsia, etc., where fever is not the most important symptom, but where the effect of certain foods must be taken into account, a special diet is prescribed. As the patient's general condition must be considered in the prescribing of such, I think it wise to make only a few general remarks on the subject, as a great deal of harm is frequently done by following set rules for medication and food, by those who are unable to recognize symptoms contra-indicating their use.

In many forms of febrile disease, as for instance tuberculosis, light diet can be given even while there is fever, nourishing food being a most important item in the treatment.

In diabetes, sugar and starchy foods, most fruits, and alcoholic drinks must be avoided. Gluten bread should be used, and that not too fresh; saccharine should be used instead of sugar for sweetening not only tea and coffee, etc., but also in cooking. Fresh milk should not be taken, but buttermilk and koumyss are allowed.

In rheumatism and gout, as in diabetes, all sweetening should be done with saccharine, and sweets of all kinds are prohibited, also pastry, puddings, jellies, pork, veal, and all fried meats. Fruit except strawberries and bananas, is allowed.



TRAY WITH FEET

Dainty Serving

Too great stress cannot be laid on the necessity for a dainty serving of the patient's meals. They should be either very hot or perfectly cold, as the case requires. Have clean napkins, spotless china, and shining silver and glass. Be careful in carrying the tray not to spill any of the fluids, and, as has been said before, do not have too much on the tray at a time.

Furthermore, that the patient may thoroughly enjoy the meal, it is necessary that she should be perfectly

comfortable. Therefore, before bringing in the tray, wash her face and hands, shake up the pillows, and decide where it is best to set the tray. If there is no bedside table or tray with feet, it is a good plan to have two blocks of wood to put on each side of the patient. They should be about the width of the tray, and high enough to hold it off the patient's chest. Magazines will answer the purpose if the blocks cannot be obtained. Always protect the night-gown and bed clothes with a towel or table napkin.

RECIPES

Milk

In warming milk for drinking never allow it to boil, and always keep it covered. It is the coagulation of the casein by boiling, and the evaporation of certain gases, that renders it indigestible. **Never Boil**

Brandy Milk with Egg

Beat one egg with one tablespoonful of sugar; add two tablespoonfuls of brandy and a cup of cold milk.

Koumyss

1 qt. perfectly fresh milk.
1-5th of a 2-cent cake of Fleischmann's yeast.
1 tablespoonful of sugar.

Dissolve the yeast in a little water; mix it with the sugar and milk. Put the mixture into strong bottles; cork them with tightly fitting stoppers; tie down securely with stout twine. Shake the bottles for a full **Five Days Required**

minute; place them on end in a refrigerator; at the end of three days lay them on their sides; turn them occasionally. Five days will be required to perfect fermentation. Kept in the refrigerator and well corked koumyss will keep indefinitely.

Milk Lemonade

1 tablespoonful sugar.
1 cup boiling water.
¼ cup lemon juice.
¼ cup sherry.
1¼ cups cold milk.

Pour the boiling water over the sugar; add the lemon juice and sherry. Stir it until the sugar dissolves; add the cold milk; stir again until the milk curdles; strain through muslin.

Milk Punch

Sweeten 1 cup of milk with 1 teaspoonful of sugar; stir in 2 tablespoonfuls of brandy; beat with egg-beater; pour into glass and grate nutmeg over the top.

Milk Rennet

Use Dainty China

Stir 1 teaspoonful of rennet and 2 teaspoonfuls of sherry together with 1 teaspoonful of sugar. Heat 1 pint of milk until it is exactly 100° F.; pour into bowl containing rennet and wine; stir quickly and only enough to mix ingredients; grate nutmeg over the top and set on ice till solid.

Peptonized Milk

Mix 5 grains of pancreatic extract and 15 of soda bicarbonate with cold milk; warm a pint of milk and add; stir well and put ón ice to cool.

Barley Gruel

Mix 1 tablespoonful of Robinson's barley-flour with half a teaspoonful of sugar; pour over this a cup of boiling water; boil ten minutes; add a cup of milk; bring to boiling point; serve very hot. **Gruels**

Arrowroot Gruel

Mix half a tablespoonful of arrowroot with 1 saltspoonful of salt, half a teaspoonful of sugar, wet with 2 tablespoonfuls of cold water; pour on a cup of boiling water, stirring constantly. Boil for twenty minutes; add the milk, and bring to boiling point; strain; serve immediately. A little port wine is often added.

Oatmeal Gruel

Mix 2 tablespoonfuls of oatmeal, half a teaspoonful of sugar and a saltspoonful of salt. Pour this slowly into boiling water; cook in a saucepan for thirty minutes, or, preferably, in a double boiler for two hours; strain; add the milk, and bring to boiling point.

Cracker Gruel

Mix 2 tablespoonfuls of cracker crumbs with half a saltspoonful of salt and half a teaspoonful of sugar. Pour over this a cup of boiling water, add one cup of milk and simmer for two minutes.

Beef Tea

Cut two pounds of round steak into half-inch squares; put into double boiler and add one quart of water; let stand one hour, then place over fire and let simmer two hours; flavor to taste.

Chicken Broth

Broths

Cut up a fowl (which has been properly cleaned) into small pieces; add a quart or a quart and a half of cold water, according to size of fowl. Let stand for one hour and simmer for two hours, then boil slightly for one. Strain it, remove fat, and flavor to taste.

Mutton Broth

Cut one pound of loin or neck of mutton into small pieces; put with one teaspoonful of chopped onion into one quart of water. Let stand one hour, and simmer three; strain; let cool; then remove the fat which rises to the top. Heat when ready to serve; season with salt and white pepper.

Flaxseed Tea

Drinks

Boil one tablespoonful of flaxseed in a pint of water for one hour; strain; add one tablespoonful of lemon juice and one tablespoonful of sugar; serve either hot or cold. The loss by evaporation should be made good from time to time, so that at the end of the cooking there shall be one pint of tea.

Coffee

For every cup of water use a heaped tablespoonful of coffee. Soak the coffee for several hours in cold

water; bring to boiling point and let simmer for a few minutes; let stand on the back of the stove for a minute to settle before serving.

Caudle

To a cupful of thin oatmeal gruel add a tablespoonful of sherry, one egg well beaten, sugar to taste; it can be served either hot or cold.

Toast Water

Toast till dry three slices of bread an inch thick; break into small pieces; add a pint of cold water; soak for an hour; strain, and squeeze the water out of the toast with the back of a spoon. Serve cold; if desired a little cream and sugar may be added.

Barley Water

Boil one tablespoonful of barley flour, a teaspoonful of sugar, a saltspoonful of salt and a quart of water together for fifteen minutes; strain; it can be flavored either with lemon juice or port or sherry wine.

Rice Water

This is made in the same manner as barley water, except that two tablespoonfuls of rice will be required to a quart of water.

Oyster Soup

Heat a cup of milk; add two tablespoonfuls of cracker crumbs, a saltspoonful of salt, a sprinkle of pepper, a fourth of a teaspoonful of butter; when this is warm through add a cup of fresh oysters and juice;

allow to simmer for about two minutes, or till the gills of the oysters curl.

Milk Toast

Toast three slices of bread a delicate brown; butter them and put them into a covered dish. Cover them with milk which has been brought almost to boiling point.

Soft Custard

Beat together the yolks of two eggs, a saltspoonful of salt, and two tablespoonfuls of sugar; add this slowly to a pint of milk which has been brought to boiling point; boil three minutes. Flavor with vanilla or sherry wine; serve cold.

Egg-nog

Egg Dishes

Break one egg into a bowl; add one saltspoonful of salt and two teaspoonfuls of sugar; beat until light; add one cup of milk, one or two tablespoonfuls of good brandy or whisky; serve immediately.

Sherry and Egg

Break an egg into a bowl; add a teaspoonful of sugar; beat the two together until well mixed; add two tablespoonfuls of sherry wine and a fourth of a cup of cold water; mix thoroughly; strain, and serve immediately.

Scrambled Eggs

Beat two eggs, a saltspoonful of salt, a sprinkle of white pepper, with a Dover egg-beater, until quite light; add four tablespoonfuls of sweet cream or milk;

turn the mixture into a double boiler; cook, stirring constantly until the albumen is coagulated.

Foamy Omelet

Separate the yolks from the whites of two eggs. To the yolks add a saltspoonful of salt and one-fourth of a saltspoonful of pepper. Beat with a Dover egg-beater until light; add two tablespoonfuls of milk. Beat the whites until fairly stiff, and fold them into the yolk; pour the mixture into a hot buttered omelet pan; cook for about two minutes; put into the oven for one minute to cook the upper surface.

Egg Cream

Separate the yolks of two eggs from the whites; add two tablespoonfuls of sugar to the yolks; beat until well mixed; add the juice and grated rind of half a lemon; place the bowl in a dish of boiling water on the fire; stir slowly until the mixture begins to thicken; add the beaten whites of eggs, and stir for two minutes. Serve cold.

Poached Eggs

Pour some boiling water into a small saucepan; salt it and add half a teaspoonful of vinegar; break a fresh egg gently into this. As soon as the white is firm lift out the egg with a skimmer, and put on crustless buttered toast.

Soft Cooked Eggs

Never boil eggs for the sick. Boil enough water to cover the eggs; put them in; remove the saucepan to

the back of the stove where the water will not lose its warmth too soon, and let them stand ten minutes.

Jellies

Jellies The order for making nearly all jellies is as follows: The gelatine is hydrated, or softened, by soaking in the cold water for half an hour. The boiling water, sugar and flavoring are then added, in the given order. Strain and cool.

Lemon Jelly

¼ box of gelatine.
¼ cup of cold water.
1¼ cups of boiling water.
½ cup of sugar.
¼ cup of lemon juice.
1 tablespoonful of brandy.

Orange Jelly

¼ box of gelatine.
¼ cup of cold water.
½ cup of boiling water.
½ cup of sugar.
1 cup of orange juice.
Juice of half a lemon.

As soon as the latter begins to stiffen it can be whipped till stiff, making orange sponge, which, served with custard, makes a very dainty dish.

Velvet Cream

Soak ¼ box of gelatine in ¼ cup of cold water for half an hour; then pour in ¼ cup of sherry wine; set

the bowl in a dish of boiling water over the fire. When the gelatine is dissolved add a teaspoonful of lemon juice and ½ a cup of sugar; strain; set the bowl in a dish of ice and water to cool. As soon as it begins to thicken turn in the cream. Stir this until it also thickens; mould and put on ice. Serve with cream.

Wine Jelly

¼ box of gelatine.
¼ cup of cold water.
1¼ cups of boiling water.
½ cup of sugar.
½ a square inch cinnamon.
1 clove.
½ cup of sherry wine.

Coffee Jelly

¼ box gelatine.
¼ cup of cold water.
1 cup of boiling water.
½ cup of strong coffee.
½ a teaspoonful of vanilla.
½ a cup of sugar.

EMERGENCIES. FIRST AID TO THE INJURED

In all emergencies one of the chief requisites is coolness. Do not get excited, or you will be perfectly useless. When the doctor's services are necessary send him a *written* statement of the case, that he may come prepared with the proper appliances. Severe injury

of any kind is apt to be followed by that complete prostration of the vital powers known as "shock." Therefore, after such, the patient should be put into a warm bed, and hot water bags applied to the feet and over the heart.

Exclude the Air

Scalds and Burns. In the treatment of scalds and burns the first object is to allay the pain by excluding the air. This is done best by the application of clean, soft, white linen or cotton cloths wrung out in a solution made by dissolving a tablespoonful of bicarbonate of soda (baking soda) in a pint of boiled water. This treatment can be continued for the first few days; afterwards boric acid ointment spread on lint or soft sterile cotton will be found healing. Do not try to treat a burn of any extent without a doctor's advice, as many complications are likely to ensue. In fact, in such cases, it is always best to send for the doctor immediately, as many people have died from shock after comparatively small burns.

Frost Bites. Rub with snow, or cloths wrung out in ice-water. The rubbing must be very light at first, and the patient kept away from the heat.

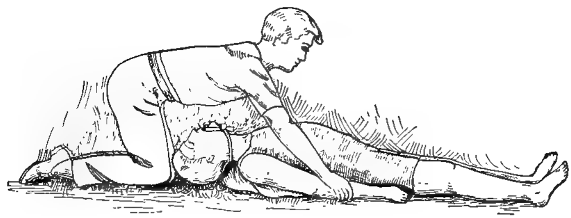
Syncope or Fainting. Place the head lower than the feet if possible; give plenty of fresh air. Ammonia may be given by inhalation, but it should not be very strong, as it is irritating to the bronchial tubes. If these measures are not successful treat as in case of shock.

Shock. Put the patient into a warm bed; undress and roll in blankets; apply heat to the extremities and over the heart; raise the foot of the bed, so that the patient's head will be considerably lower than the feet. If possible avoid giving stimulation till the doctor arrives; if, however, he cannot be found, and the case is urgent, give a rectal injection of whisky 1 oz., water 5 ozs. (105° F.), salt 5 grains. Coffee may be used instead of water and salt.

Epilepsy. Loosen all clothing; put something between the teeth to prevent the tongue being bitten; have the head on a level with the feet; give plenty of fresh air but no stimulants.

Drowning. In cases of drowning where a person is apparently lifeless, efforts to restore life should be commenced at once by loosening all tight clothing around neck, chest, and waist. Turn the patient over quickly on his face, raising the body slightly at the waist to allow any water in the throat or air passages to run out. Wrap a handkerchief or a towel around the forefinger and gently cleanse the mouth. All this should take only a minute or two. Place the person upon his back with a folded coat or a firm pad of any kind under his shoulders to raise them a little. Be careful that the tongue does not slip back and shut off the air from the trachea. If it shows any tendency to do so, have some one hold it out, or tie a handkerchief around it and then around the neck.

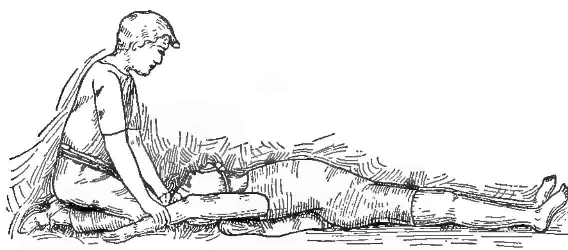
Now artificial respiration should be produced until the natural breathing is restored. To do this kneel



ARTIFICIAL RESPIRATION (First Movement)

Artificial Respiration

behind the patient and grasping his arms just below the elbows, draw them slowly upward above his head until they nearly touch. Give a firm pull for a moment. This movement tends to fill the lungs with air by raising the ribs and increasing the chest cavity.

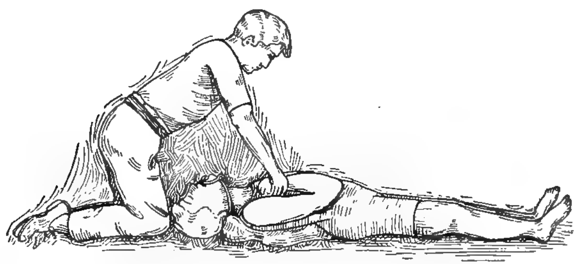


ARTIFICIAL RESPIRATION (Second Movement)

Then carry the arms slowly back to the sides of the body and press them against the ribs. This movement forces out the air which was drawn into the lungs and makes artificially a complete respiration. These two

movements should be repeated slowly and steadily about sixteen times in a minute, until respiration takes place naturally. This may require an hour or more.

Asphyxiation, Caused by Gas, Smoke, etc. Remove the patient into the fresh air, loosen the clothing, throw cold water in the face, neck, and chest; apply heat to the feet and over the heart. If respiration is



EXPELLING THE AIR (Third Movement)

shallow, artificial respiration should be performed, and, if necessary, treat as for shock.

Contusions, or Bruises, are best treated by rest and cold applications.

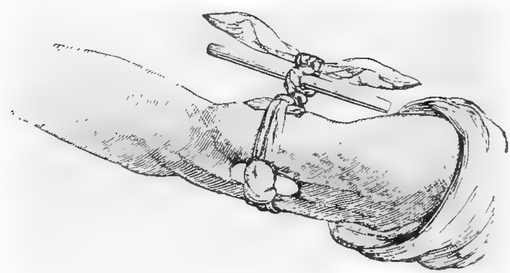
Guarding Against Blood Poisoning

Wounds. When there is a cut, the first procedure, provided there is no hemorrhage, is to wash out the wound well with bichloride, 1-5000, and bind it up with sterile gauze. A wound will heal without the formation of pus if all bacteria are killed or kept out. When the cut is long, or the ends of the wound do not come together well, the doctor should be summoned, as putting in a few stitches may prevent an unsightly

scar. (Having bichloride and sterile gauze always in the house would save many a case of blood poison, infected fingers, etc.) Collodion is useful in keeping bacteria out of small cuts and in applying absorbent cotton over wounds in places where bandages cannot be used.

Tourniquet

Hemorrhage. Elevate the affected part; make compression over the wound by applying clean compresses and bandaging tightly. If this does not check it, and you do not know the course of the arteries well enough



Manner of compressing an artery with a handkerchief and stick.

to make compression upon the required one, tie on a bandage very tightly above the wound. A pencil or a piece of wood stuck under this, and turned around, will act as a tourniquet. When possible, in addition to this it is always better to place a hard pad over the course of the artery. A doctor's aid must be sought immediately, for if the blood is shut off in this manner longer than an hour gangrene is likely to set in.

Epistaxis (bleeding from the nose). Make the patient stand or sit erect; throw the head back and elevate the arms, while you apply ice or ice-cold compresses to the forehead and back of neck. If the bleeding still continues the nostrils should be syringed with salt and water, ice cold. Avoid blowing the nose, and so disturbing the formation of clots. **Cold Applications**

Hemorrhage from the Lungs. Keep the patient quiet, give crushed ice, and put ice-cap on chest. Salt solution made by dissolving a teaspoonful of salt in a small cup of water may also be given.

Sprains occur most frequently at the wrist and ankle joint. Soak the affected part in hot water, or apply hot compresses. The joint should then be supported by strapping, and given moderate use. A surgeon should do the strapping, for if it is not properly done serious trouble may result. **Strapping**

Fractures. It is a mistaken impression that a fracture must be set immediately. It will do less harm for it to be left a day or two without splints than for them to be applied awkwardly. Handle the injured limb as little as possible, and keep the patient quiet until a competent surgeon can be obtained. Temporary splints made of pasteboard, shingles, etc., may be bound on to prevent the spasmodic twitching of the muscles; cold or hot compresses applied will keep down the swelling and relieve the pain. **Fractures Need Not Be Set At Once**

Dislocations should be reduced as soon as possible, but only a surgeon can do this properly.

FOREIGN BODIES IN THE EYE, EAR, NOSE, THROAT

The Eye. If anything gets under the lower lid, draw the lid down by the lashes, direct the patient to turn the eyeball toward the nose, and the offending body can then be wiped out with a soft handkerchief. If it is under the upper lid, this can be turned up over a thin pencil or knitting needle, and treated in the same way, except that the patient is directed to look down. Always wipe the eye towards the nose. If the particle is imbedded in the surface of the eyeball a surgeon must be notified immediately; do not make any effort to get it out.

Use Nothing But Water

Foreign Body in the Ear. Unless the object is something that will swell with moisture, syringe gently with warm water, taking care not to close the opening with the nozzle of the syringe. If this method fails go to a doctor; any unskilled effort to poke or probe the object out is likely to result in permanent injury to the ear.

The Nose. When a foreign body is in the nostril make the patient take a full breath, then close the mouth and the other nostril firmly—the air will probably expel the obstruction. If this fails, and the object is in sight, compress the nostrils above and hook it out with a hairpin or piece of bent wire.

A Foreign Body in the Throat may be hooked out in the same way; if not, a piece of bread should be swallowed; this may carry down the obstruction. Do not give purgative medicine, as is often done, but

rather plenty of solid food, especially potatoes and bread.

A Foreign Body in the Windpipe will usually be dislodged by the coughing which its presence excites; if not, a blow on the back, or, in the case of a child, holding it up by the feet and administering a succession of blows between the shoulders will generally produce the desired effect.

POISONS AND ANTIDOTES

The treatment has three objects in view: to remove the poisonous substance, neutralize its further action, and remedy the ill effects already produced. An emetic is the first consideration. A tablespoonful of salt or mustard stirred into a glass of lukewarm water will usually prove effective. This dose should be repeated three or four times. An enema should also be given, the patient kept warm, and, as soon as vomiting ceases, the chemical antidote given. **Give an Emetic At Once**

The following table of the chemical antidotes and further treatment of the most common poisons should be learned and remembered.

Carbolic Acid. Lime water and milk, equal parts, a pint to a pint and a half. Atropine and heart stimulants, such as whisky and strychnine, may be required, given hypodermically.

Nitric or Oxalic Acid. Chalk or whiting, the plaster from walls, milk and lime water. Give whichever can be obtained quickest.

Ammonia. Vinegar or lemon juice, followed by castor or olive oil.

Arsenic. The best antidote is tincture of iron, diluted with water, and either baking or washing soda. Lacking this, or till it can be obtained, give milk and white of egg, or flour and water.

Aconite or Belladonna. Strong, hot coffee. Give artificial respiration if necessary.

Bichloride of Mercury (corrosive sublimate). White of egg—white of two eggs to a pint of water.

Calomel. The same as bichloride of mercury.

Opium. Strong, hot coffee. Keep the patient awake, using artificial respiration when necessary; permanganate of potash and tannic acid are the best chemical antidotes, but they can rarely be obtained in a hurry.

BANDAGES AND BANDAGING.

Materials The materials most commonly used for making bandages are either unbleached muslin or gauze. Muslin bandages are best when necessary to keep a splint in place, or make firm pressure. Gauzes are infinitely preferable when the object is only to keep a surgical dressing in position; they adapt themselves more neatly to the part, and are much cooler.

Bandages should be six to eight yards long; they vary in width from one inch to four; one inch for finger bandages, two for hands and feet, two and a

half to three for head and arms, three to four for legs, spicas, etc.

The three fundamental forms of bandaging are: the spiral, reverse, and figure eight.

Figure Eight Bandage

The figure eight principle is the one most used, and is the easiest method to learn. It is made by turning the bandage round the limb in the form of the figure 8, each figure being higher than the preceding one, but overlapping it one-third of its width. A bandage must lie smoothly without wrinkles, making an even but not too severe pressure. It must not be loose enough to slip, yet not tight enough to be painful or impede the circulation.

Finishing

When finishing a bandage always put the pin on the outer side of a limb, and in all cases where it will least interfere with the patient's comfort. Safety pins should always be used.

In bandaging a limb begin at the extremity, and work upwards from left to right. Hold the bandage with the roll side upward.

Foot Bandage

To bandage a foot start the free end of the bandage at the instep, make a turn around the base of the toes, carry the bandage diagonally over the foot, across the point of the heel, and back from the other side till it coincides with the first turn. Cover this, and carry a second turn around the heel, half an inch higher than the first. Continue making alternate turns under the sole and behind the heel, crossing over the instep, until the foot is covered. Finish with a couple of circular

turns around the ankle, or, if desired, continue up the leg.

Leg Bandage

The beginning of the leg bandage is placed obliquely across the leg above the ankle; a circular turn keeps it in place; then the bandage is inclined up the leg, and a turn taken around it. It is then brought downward, and another turn taken around the ankle. Suc-

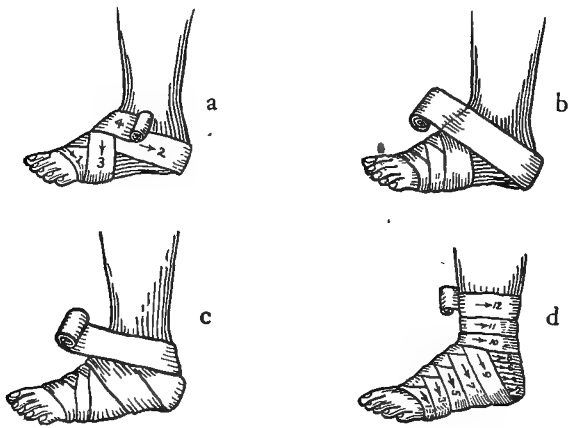


FIGURE 8 OF THE FOOT.

cessive turns are to be made, each one higher than the preceding, till the entire limb is covered.

To bandage a hand begin at the top of the first finger and cover it by a succession of oblique circular turns, or figures of eight, to its base. Then make a turn around the wrist to keep these from slipping, and return to the root of the second finger. Lead the

bandage by one or two spirals to the top of this, then proceed down it, as upon the first finger, concluding with another turn upon the wrist. Cover each finger successively in the same way; then take a wider bandage, start at the back of the hand and wind it around the base of the fingers, carry it obliquely across the back of the hand around the wrist, back to the further side, and again around the palm. Continue these turns alternately till the hand is covered. The arm is bandaged in the same manner as the leg.

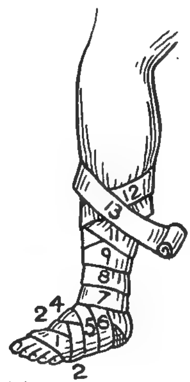


Figure 8 of the Leg

Forehead or Back of Head

When it is only necessary to cover the forehead or back of the head the figure-of-eight is all that is required. Start the bandage over the ear, carry it across the eyebrows and around the back of the head as high as possible. Continue to wind it round thus, making

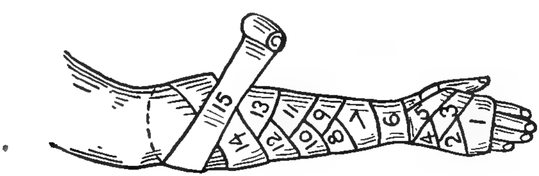
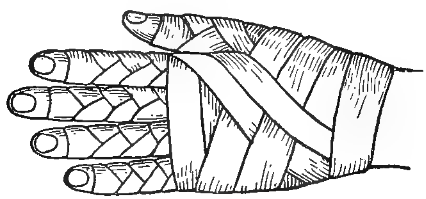


FIGURE 8 OF THE ARM.

each turn a little higher in the front, and lower in the back, until you have covered as much surface as required. When the whole head needs covering the capeline is better. This is put on by a

The Capeline

double roller (join two bandages by rolling). Stand behind the patient, and, taking one roll in each hand, begin low on the forehead and carry them round the head, far down on the nape of the neck; then transfer the bandage in the left hand to the one in the right, and continue it round, while the other is folded over at right angles with it, and brought across the top of the head to the front. Here it meets the other and crosses it again, running backward and overlapping the former folds. These turns are continued until the



Bandage of the Hand

whole head is covered, one bandage going round and round it, and the other going back and forth across it; all the folds leading from the front of the head to the back should be on the left of the middle, while those leading toward the front should be on the right. Finish with a circular turn around the head; fasten with a safety pin in front.

The tailed bandages are often found very convenient, especially for keeping poultices and the like in position.

Four Tailed Bandages

The four tailed bandage of the head is made from a piece of muslin eight inches wide and long enough

to go over the scalp and tie under the chin. It is torn from each extremity to within three or four inches of the middle. The body of the bandage is placed on

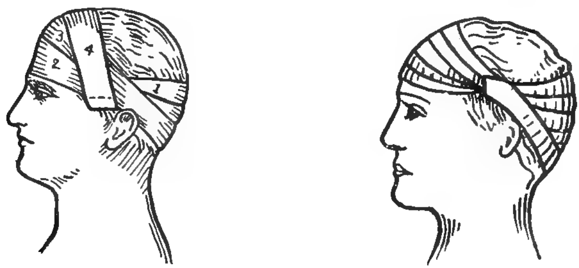
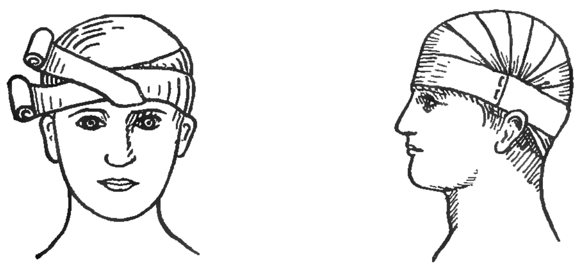


FIGURE 8 OF THE HEAD

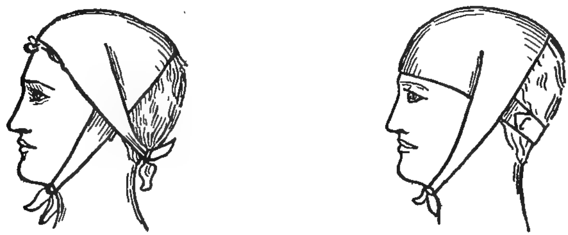
the top of the head, the two posterior tails tied under the chin, and the two anterior ones around the back of



THE CAPELINE

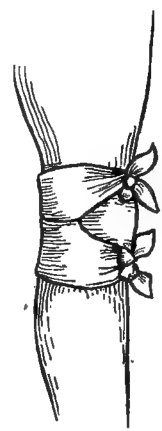
the neck. If it is desired to cover the front of the head the body of the bandage is placed at this point, the two anterior tails are fastened at the back of the head, and the two posterior ones down under the jaw.

A four tailed bandage for the knee is made by splitting a strip of muslin at each end, to within two or three inches of the center. Place the body of the



FOUR-TAILED BANDAGE OF THE HEAD

bandage over the knee, carry the tails under the knee, cross them so that the lower ones will come above the joint, and the upper ones below; bring them around, and tie in front.

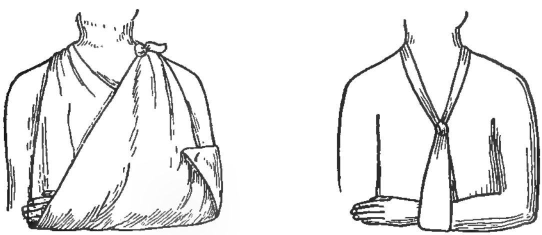


Four Tailed Bandage of the Knee

Scultetus A scultetus, or many tailed, is used on the abdomen, to obtain pressure, to keep a surgical dressing or poultice in place, etc. To make it take four or five strips three inches wide and a yard and a quarter to a yard and a half long, sew them together in the center for a quarter of a yard, each one overlapping the other by two-thirds of its width. To apply, pass the bandage under the patient, so that the sewed part is under her back; fold the strips alternately over the abdomen, from below upward.

Slings

To make a sling take a square yard of muslin and cut it across diagonally; this makes two slings. When the fore-arm is injured its whole extent should be supported equally. Put it in the center of the sling; carry its outer end around the neck on the side of the injured arm, and the end between the arm and the



SLINGS FOR LOWER AND UPPER ARMS

chest around the other side, tying them at the back. The third end is brought around the elbow and fastened in front.

Sling for Upper Arm

If the injury is of the upper arm the sling should support the wrist only, making no pressure on the elbow. Turn the hand palm inward, fold the apex of the bandage in place, the arm just above the wrist in the center of the sling, cross the ends and tie them around the neck.

The student should practice the various bandages and slings described on some member of the family or a friend. Some little experience is required before they can be applied securely and neatly. The illustrations will help to make the matter clear.

BIBLIOGRAPHY

Food and Cookery for the Sick and Convalescent ($1.50). Fannie M. Farmer.
Food for the Sick ($1.00). Edward C. French.
Home Nursing ($1.00). Eveleen Harrison.
Nursing ($2.00). Isabel A. Hampton.
Practical Normal Histology ($1.25). T. Mitchell Prudden.
Practical Points in Nursing ($1.75). Emily A. N. Stoney.
Text Book of Nursing ($1.75). Clara Week Shaw.

MAGAZINES

The American Journal of Nursing.
The Trained Nurse.

Note.—For the convenience of students the School will purchase and forward any of the above books on receipt of the price given.

TEST QUESTIONS

The following questions constitute the "written recitation" which the regular members of the A. S. H. E. answer in writing and send in for the correction and comment of the instructor. They are intended to emphasize and fix in the memory the most important points in the lesson

HOME CARE OF THE SICK

PART II

Read Carefully. Place your name and address on the first sheet of the test. Use a light grade of paper and write on one side of the sheet only. *Do not copy answers from the lesson paper.* Use your own words, so that your instructor may know that you understand the subject. *Carry out the directions given in the text, if possible, before answering the questions.*

1. How are infectious and contagious diseases alike? How do they differ? Name some of each.
2. What precautionary measures should be taken with typhoid fever? With consumption?
3. What are the rules when isolation is necessary?
4. What precautionary measures should be taken by the attendant while nursing in a contagious disease?
5. How disinfect (a) the patient, (b) the room, (c) the furnishings at the termination of a contagious disease?
6. Why are the many precautions taken in surgical operations and in childbirth?
7. What can you say of diet for the sick? Why should special care be taken in serving?
8. What should the medicine closet contain in preparation for emergencies and accidents?
9. How would you treat a scald or burn? Frost bite? A wound?
10. What is shock and how should this condition be treated?

11. Why should written directions be sent to the doctor in accidents?
12. What would you do for a sprain? Fractures? In case of hemorrhage from an arm or leg?
13. What should be done at once for one who has fainted? One apparently drowned? Asphyxiated?
14. Give the rules of hygiene in pregnancy.
15. Name some of the things to be provided for childbirth. How should the room be prepared?
16. Describe the stages of labor.
17. What should be done if the doctor does not arrive in time?
18. How should the child be cared for directly after birth?
19. How would you remove a foreign body from the eye? Ear? Nose? Throat?
20. In case of poisoning, what objects has the treatment in view?
21. What would you do for carbolic acid poisoning? Bichloride of mercury? Arsenic? Opium?
22. Of what material are bandages made? How should they be applied and fastened?
23. Bandage a foot as shown in the illustration and then describe the process.
24. Try some of the other bandages described and report.
25. Make and adjust a sling for the forearm. When should it be used?
26. What questions would you like to ask in connection with these lessons? Tell of any experience that you may have had in nursing and of methods that were helpful.

NOTE.—After completing the test sign your full name.

PREVENTABLE DISEASES

CONSUMPTION

Circular of Information for Persons Suffering From Pulmonary Disease, and for Others Living in the Same House

Issued by the National Association for the Study and Prevention of Tuberculosis, 105 East Twenty-second Street, New York.

GENERAL CONSIDERATIONS

Several diseases of the lungs are spread from person to person by the coughing and spitting of those affected. Among these diseases are Consumption, Influenza or Grippe, Bronchitis, Common Colds, and Pneumonia. Those who suffer with any of these affections cannot help coughing and spitting, but they can cough and spit in such a way as to avoid communicating their disease to others.

COUGHING

The infective agent, or "germ," is contained in the material raised by coughing. Very small bits of such material may contain large numbers of these germs. Most persons, when coughing, instinctively hold the hand over the mouth. That is not a very bad habit, for you may at least know what you have done. You have possibly infected your hand, but have not prevented the act of coughing from scatter-

ing about you fine particles of saliva, which may contain bacilli. It is better to hold a handkerchief* over your mouth, and, when done coughing, to put the handkerchief at once into the pocket — into the handkerchief pocket, into which a small paper bag has been previously placed to prevent contamination of the pocket, and which can be burned when convenient. If accidentally you cough anything, no matter how little, into your hand, you should clean your hand very carefully. If one has tuberculosis or pneumonia it is most important, indeed it is almost vital to persons around, to avoid cantaminating the room with materials coughed up.

Persons subject to prolonged attacks of coughing should, if possible, retire to a convenient place until the fit is over, and under all circumstances should be careful that the fine spray coughed up is all caught upon some material which can be completely and promptly destroyed.

The material expelled by coughing is, as a rule, small in amount, and consists of minute droplets, but its power to infect is not to be judged by the small amount or by the minuteness of its particles, for the tiny germs are plants, each of them capable of rapid growth when transferred to the lungs of another person.

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*Note.— The use of handkerchiefs for this purpose might well be discouraged, for the mouth and nose secretions of healthy people often contain disease germs. Japanese napkins, tissue paper, or pieces of cloth which can be destroyed, are preferable on all accounts.

Persons in health need have no fear whatever of the matter exhaled by the sick in ordinary breathing or in conversation.

SPITTING

The larger quantities of material, coughed up into the mouth, contain enormous possibilities of infection, but this source of danger is easily avoided by simply knowing where to spit.

Many persons, women especially, swallow what they cough up. This is a bad habit. It is most unclean and disgusting to spit into your stomach, and if one has tuberculosis it is dangerous. Consumptives would oftener get well if they were not repeatedly reinfected, and to swallow the sputum is one way of renewing the infection.

Those who have ordinary colds or pneumonia, or influenza, or tuberculosis, must spit, but they must not spit in such a way that they themselves or any other person can come in contact with any particle of the sputum.

In the house no one, sick or well, should ever spit anywhere except into a vessel made for such purposes. Those who are out of health should have their own spittoons containing water or some disinfecting solution, or sputum cups of paper cheap enough to be dropped in the fire and destroyed, or a water-proof pocket or paper bag for cloths or absorbent paper napkins, which are burned as soon as they are soiled. A disinfecting solution in the spittoon is not absolutely

necessary, but it is absolutely necessary that the sputum should never be allowed to dry, and water in the spittoon will answer every purpose to accomplish this end. Spittoons should have perpendicular sides, and no slanting surfaces on which the sputum can stick and dry. It is well to place the spittoon on a piece of paper which will show if accidentally soiled, and can be easily destroyed. It is dried sputum, from which particles can rise as dust in the air, that is dangerous.

For use on the street, or away from home, similar conveniences can be obtained, capable of being used quite decently and without attracting attention. If one happens to be without such conveniences, when it is absolutely necessary to spit, remember not to spit where anyone is liable to step on the sputum. It is a punishable offense to spit on the floor or platform of a trolley car or railway coach or on the floor of a railway station or public building, and in many places the law forbids spitting on a pavement. When you must spit, look about for a sewer opening or a gutter.

When in company, and in a room, the tendency of the invalid is to swallow the sputum rather than attract attention, but this should not be done, as it is both dangerous to the patient and disgusting, and the expectoration can always be received on pieces of cheesecloth; or it would be better even, if necessary, to expectorate in the handkerchief and burn it afterwards.

Of the diseases considered in this circular the most important from every standpoint is tuberculosis. This disease, when it affects the lungs, is commonly called consumption. Nearly all diseases of the lungs are communicable in some degree, and the advice given in this circular can be followed with advantage by *all persons who have cough or expectoration.*

TUBERCULOSIS OR CONSUMPTION

Tuberculosis of the lungs, commonly called consumption, is the most common form of the disease. There is also tuberculosis of the throat, known as consumption of the throat; tuberculosis of the bowels, called consumption of the bowels; tuberculosis of the lymph glands, known as scrofula; tuberculosis of the various bones, as of the spine, which is the cause of hunch back; tuberculosis of the joints, as of the hip, which is known as hip-joint disease; and various tuberculosis abscesses, known as white swelling.

Tuberculosis is a communicable disease.

Tuberculosis is a preventable disease.

Tuberculosis is a curable disease.

It is communicated from one person to another through the discharges from tuberculous ulcers, the principal source being the sputum which comes from ulcers in the lungs of persons suffering from consumption.

It is a preventable disease, because if these discharges which contain bacilli were destroyed, there would be no spread of the disease.

That it is curable is proven by the fact that more than one-half of the people have tuberculosis some time in their life, and yet only about one in seven die of it.

FIRST STEPS IN THE PREVENTION OF THE SPREAD OF CONSUMPTION

If the spread of consumption is to be prevented, the disease should be discovered as early as possible, and the patient should be told that he has the disease. He should at the same time be told that the disease is curable and that, in order to be cured and in order not to give it to others, he must know that he has it. If the disease were discovered early and the patients thoroughly instructed and trained in being careful, there would be little danger of scattering infection.

If you have a cough, don't say, "It's nothing but a cold." You may be injuring yourself and others. Go to a doctor who knows, and learn the truth.

Persons suffering from tuberculosis should earnestly desire to know that they have tuberculosis, that they mav take advantage of the modern methods of treating the disease and be restored to health. They should know that "bronchial trouble," "throat trouble," "stomach cough," and such terms, are only deceptive and mean, in many cases, consumption They should also know that the spitting of blood, unless positively from the gums, nose or throat, is in all probability from tuberculosis in the lung. Repeated protracted colds are often signs of tuber-

culosis. A cough that hangs on for any length of time should always excite suspicion.

DISPOSAL OF THE SPUTUM

The expectoration of persons suffering from diseases of the lungs always contains infective germs, and the expectoration of consumptives is particularly harmful. The matter spat up by consumptives may soil the bedding, furniture, clothing, etc., and other persons handling these things may soil their hands and thus infect themselves. Consumptive persons are very likely to soil their hands through the pocket handkerchiefs which they use. It is best for persons suffering from any pulmonary disease not to use the ordinary pocket handkerchief at all. The Japanese paper napkins, tissue paper, or pieces of gauze, as as they are used but once, are less apt to soil the hands, and can be burned as soon as used.

The best way of destroying sputum is to burn it. A number of disinfectants will destroy its infectiousness, but their action is slow, uncertain, and they are more expensive than burning. Paper cups to receive the sputum are often furnished by State and Local Boards of Health, or they can be purchased at drug stores. These cups should be burned every day or every other day. In summer, when there is no fire in the house, a fire should be made with waste paper and wood for the purpose of burning the cups and paper napkins which have been used. The cups and napkins may be thrown into an earth closet and

covered with dry earth or lime, as the germs soon die under these conditions. In hotels, flats and apartments, where there is no access to an earth closet or a fire, the patient should spit into a cup containing water or a disinfecting solution, and empty it every day into the water closet. In the earth closet and water closet the germs are not destroyed at once as by burning, but they cannot harm the patient or any one else, and they soon die.

The sputum must not be thrown on the ground, or into a surface gutter, or thrown away with ashes, garbage, or other refuse. The cover of the sputum cup should be kept closed to keep out *flies* and *other insects*, which may carry the sputum on their legs and bodies and distribute it wherever they afterwards alight.

Sick persons who are walking about, away from home, where they cannot carry sputum cups, should spit into a Japanese paper napkin, tissue paper, or cheese-cloth, and put it at once into a waterproof pocket, or paper bags can be used for this purpose. The waterproof pocket may be sewed or buttoned into the left pocket of the skirt or trousers. A supply of unused napkins should be carried in the right pocket. The paper napkins should be used only once. Sick patients, too weak to use the cups, should spit into Japanese napkins, bits of tissue paper, or pieces of gauze, which can be kept in a covered pasteboard box or tin bucket, and afterwards burned.

It is well always to wipe the lips after expectorating. If the sputum accidentally gets on the floor, clothing, or furniture, a thorough washing with laundry soap and water should immediately be applied.

Persons whose sputum contains disease germs, especially those of tuberculosis, should frequently wash their hands with soap and water. Patients who cook or prepare food should take especial care to have clean hands.

The beard and moustache are sure to be infected, and probably help the consumptive to reinfect himself by contaminating his food and drink. The beard should be removed or trimmed quite short.

SPECIAL DIRECTIONS FOR MEMBERS OF THE HOUSEHOLD

Young children should not be allowed to play in the sick-room of anyone who has any disease of the lungs. Playing on the floor of the sick-room especially should be absolutely forbidden.

The germs of consumption are more dangerous for children than adults.

Mothers with tuberculosis should not nurse their infants, as nursing involves a considerable danger to the child and a heavy drain upon the mother's vitality. Mothers should thoroughly wash their hands before preparing the bottles or handling the infants' food.

Patients with pulmonary disease should *not kiss* anyone on the mouth. If the mouth and lips have

been carefully cleansed, kissing perhaps is but slightly dangerous.

Towels, pipes, clothing, handkerchiefs and other personal articles used by a tuberculosis person should not be used by other members of the family. When consumptives are bedridden their clothing and bedding ought not to be thrown into the common receptacle for soiled clothes. Such things as can be boiled should be boiled as soon as possible, or else soaked for several hours in a disinfecting solution.

CARE OF THE SICK-ROOM

A person suffering from consumption should occupy, if possible, a sunny room, and one that can be well ventilated. If the room is not so arranged that there can be good ventilation, so as to frequently change the air, the patient should draw his bed near the window, so as to get as much fresh air as possible.

If the floors and walls of the room have become soiled by sputum the room should be disinfected by formaldehyde gas. If possible, the room should be disinfected, and afterwards the walls scraped, and repapered, repainted, or rekalsomined. After that the walls should not become infected again in many months, provided the coughing and spitting are properly cared for.

The floors may be washed with hot soda lye. The floor should be bare or covered with wash cotton rugs.

Heavy curtains should be removed, and sash

curtains of washable materials substituted. Roller shades are not objectionable, unless they exclude too much daylight.

Do not sweep or dust the room. The floor should be wiped at least once a week with a damp cloth. The bed, furniture, woodwork, mantels, etc., should be wiped off in the same manner.

The patient should have his own bed, and if possible his own room. It is injurious to the invalid and dangerous to the well person to occupy the same bed.

The bedroom should not be used as a dining-room or kitchen if it is possible to avoid it.

The windows should be kept open.

The cardinal principles to be observed in the sick-room are cleanliness, sunlight, fresh air, and care of the sputum.

THE CURE OF DISEASES OF THE LUNGS

Consumption is not a very fatal disease. The majority of those attacked recover. More than in any other disease the outcome of a case of tuberculosis is in the hands of the patient. The development of consumption is caused by errors in our ways of living; some of these are nature's errors, some errors of circumstance, and some our own personal errors. Medical experience has shown that we can easily overcome the adverse chances of nature and circumstance if we correct our personal errors of hygiene.

HOW TO MAKE HEALTHY LUNGS DISEASED

1. Exposure to dust containing germs.
2. Drinking excessive amounts of alcoholic liquor.
3. Loss of sleep, worry and confinement.
4. All forms of dissipation and excess.
5. Unwholesome and improperly cooked food.
6. Meals at irregular hours.
7. Working or living in a dusty or vitiated atmosphere.
8. Prolonged hours of work. Severe and prolonged muscular or mental exertion. Work requiring a constrained or stooping posture.
9. Exposure to extreme heat, noxious fumes, injurious dust, dampness.
10. Certain occupations: Stone-cutting, file-grinding, and dusty occupations generally.
11. Contracting diseases which aggravate or predispose to consumption — measles, whooping-cough, grippe, and pneumonia.
12. Exposure in the room of a careless consumptive.
13. Drinking of milk of tuberculous cows, especially by children.

HOW TO MAKE DISEASED LUNGS HEALTHY

1. The person suffering from tuberculosis should be careful to destroy his sputum. He should not soil his hands, handkerchief, clothes, bed clothes, or anything about him with his expectoration. In case any of these should become soiled, they should be cleaned and disinfected

at once. He should not swallow his expectoration; he should not associate with other persons who have the disease and are careless about their expectoration, for by carelessnes on his own part or that of others he may be reinfected.

2. Employ an intelligent physician. Consult him about food, drink, work, rest, amusements, exercise, and all the details of daily life, including the expediency of going to a sanatorium, or adopting sanatorium regime in your own home.
3. Don't spend one cent for advertised cures, for they never cure.
4. Take the four cures:
   The air cure;
   The food cure;
   The rest cure;
   The mind cure.
5. Sleep well, don't worry, keep out of doors. Be confident that you are going to get well.
6. Don't take any liquor, except on a physician's prescription.
7. Eat plenty of meat, milk, butter and eggs — all you want, and want as much as you can eat.
8. Avoid the frying pan and its products.
9. Keep regular hours, good company and a clear conscience.

10. Your most inportant duty is to get well; let all other duties be secondary.
11. If your work involves long hours, prolonged and severe mental or muscular exertion, stooping position, inhalation of dust or noxious fumes, leave it if you want to get well.

HOW TO KEEP HEALTHY LUNGS HEALTHY

1. Keep your general health in as good condition as possible by avoiding excess, and by living as hygienically as possible.
2. Follow the foregoing rules as faithfully as your occupation permits.

Numerous investigations have shown that prolonged and repeated exposures are necessary to cause tuberculosis in a healthy person; accordingly there is little danger to be feared from casual exposure to consumptives.

Any one may safely live in the same apartments with a consumptive, provided the simple precautions given in this Circular of Information are observed.

Tuberculosis is not a contagious disease like measles or small-pox. It is, however, a communicable disease, and we know just where the danger lies and how easy it is to avoid it. It is not the consumptive himself, but the consumptive's expectoration which is dangerous to those about him. If the simple directions given above are followed by him, the con-consumptive ceases to be a source of danger to those about him.

AS TO CHANGE OF CLIMATE

Climate in Consumption is a will-o'-the-wisp. It is the end of the rainbow with its pot of gold. It is ever just a little beyond. It rests in Colorado, New Mexico, Arizona, California. Like children in their simple faith, chasing the rainbow's vanishing end and delving for treasures where once it stood, our patient pursues his phantom till, worn and wasted, weary, but hopeful still, he falls asleep and wakes to learn that the magic end of the bow of promise rests upon the mystic shores of the spirit land.

"While certain climates may be preferred for certain consumptives, it is nevertheless the consensus of opinion of the leading authorities of the day that there is no climate which has a specific curative power over consumption. Many, including Dr. S. A. Knopf, of New York, an acknowledged expert on the treatment of Consumption, hold that cures effected in the home climate in which the patients will have to live and work after their restoration to health, are more lasting and assured than cures obtained in more genial climes. While it is known that patients cured in the salubrious regions of the West have been able to return and live in Illinois and eastern states from whence they came, it is also known that others can never leave the climates in which they recovered, for on their return to their own state their disease recurs.

"There are many reasons why an attempt should be made to cure a consumptive patient at or near his

own home, if it be in a climate not unsuitable for the cure of Consumption; many reasons why he should not be sent a long distance from home.

Separation from friends depresses the patient. "Homesickness" is a malady which often baffles the physician.

The expense of the journey is a serious drain on his resources and is often incurred unnecessarily. As has been aptly stated by the State Board of Health of Maine. "many patients could be well put on the road to recovery in their own state at a cost which would barely defray their expenses to and from Colorado and Arizona."

The fatigue of a long journey is bad for a consumptive.

The lack of home comforts in a distant state and the inability often to obtain proper accommodations unless at a prohibitive price naturally handicap the best efforts made to cure the patient.

The expense of living in the states having "specific" climates is great. Even if his disease be cured, the patient may not be able to return to live in his home state.

If the patient must work, he can find no occupation. Too many have preceded him.

It is known that in certain Western states doors are closed to the consumptive, and legislation against him is contemplated.

For the wealthy patient, who can be surrounded

by his relatives and friends wherever he goes, a change of climate may be desirable; for the poor patient—and Consumption is often a disease of the poor—a change of climate frequently quickens an unfavorable termination of his disease.

The consumptives of Illinois should not forget that their disease can, as a rule, be cured in Illinois, if it can be cured anywhere.—*Bulletin on Consumption, Illinois State Board of Health*

THE GREAT WHITE PLAGUE

"It is with a very real sense of melancholy that one contemplates the long death-roll of those of the world's great men and women who have succumbed untimely to the tubercle-bacillus, which is and has been through countless generations by far the most potent of all death-dealing agencies. Had it not been for this detestable parasite, Bastien Le Page might have given us another Joan-of-Arc to feast our eyes upon; Rachel might for many years have continued to permeate the spirits of her audiences with the divine fire that was in her. Our navy did well enough in the 1812 war, as all the world knows; but what a rip-roaring time there would have been if John Paul Jones had lived to take a hand in it! We might be reading some more of Stephen Crane's splendid war stories; we might have had some more of Robert Louis Stevenson's delicious lace-work; Schiller might have given us another Song of the Bells; we might

have taken another 'Sentimental Journey' with Laurence Sterne; Henry Cuyler Bunner might have continued to delight us, and to touch our hearts; John Keats might have given us another 'Endymion.' Had the tubercle-bacillus permitted, Nevin might have vouchsafed us another 'Rosary'; von Weber another 'Euryanthe Overture'; Chopin might have dreamed another 'First Polonaise'; and the tender flute notes of Sidney Lanier might even now be heard. Maria Constantinovna Bashkirtseff, Zavier Bichat, John Godman, Rene Theophile Hyacinth Laennac, Henry Purcell, John Sterling, Henry Timrod, Artemus Ward, Henry Kirke White, Henry David Thoreau, Baruch Spinoza—such names as these are but a moiety among those of the world's nobility whose precious lives were cut off in their prime by the 'Great White Plague.' "—*From Popular Science Monthly, by Dr. John B. Huber.*

Of the people living in the United States to-day over 8,000,000 will die of tuberculosis, at the present death rate. All these lives might be saved.

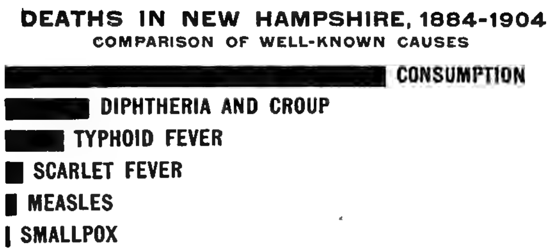
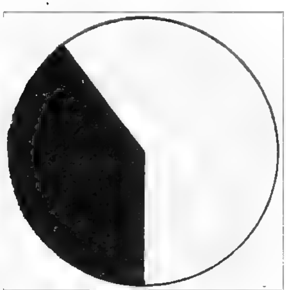
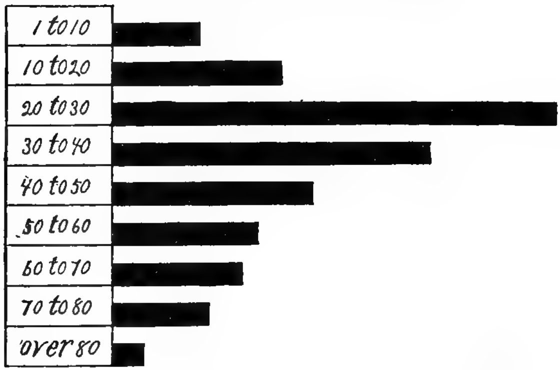


DIAGRAM OF PREVENTABLE DISEASES.

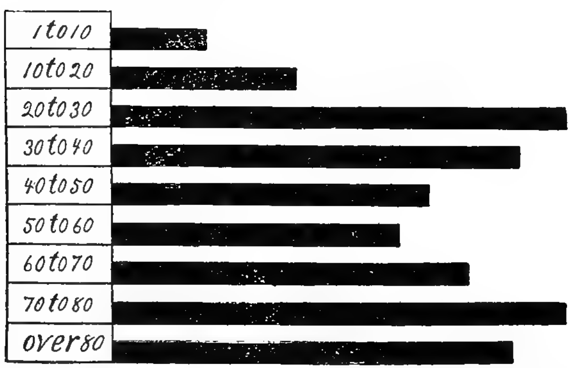


During this period there died in New Hampshire, from all causes, between the ages of 20 and 30, 10,028 persons, of whom 3,981 succumbed to consumption; or, in other words, 39.69 per cent., or one to two and a fraction deaths were caused by consumption.

DIAGRAM SHOWING PROPORTION OF DEATHS FROM CONSUMPTION TO DEATH FROM ALL OTHER CAUSES BETWEEN THE AGES OF TWENTY AND THIRTY YEARS. BLACK, CONSUMPTION; WHITE, ALL OTHER CAUSES.



DEATH RATE FROM CONSUMPTION IN NEW HAMPSHIRE BY AGES.



MORTALITY FROM CONSUMPTION TO EACH 10,000 OF THE SAME AGE, IN NEW HAMPSHIRE, FOR 20 YEARS.

PNEUMONIA*

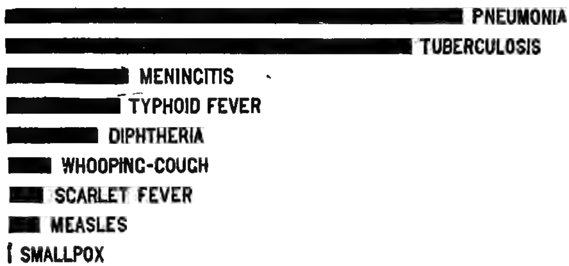
Definition.— Pneumonia is an infectious inflammation of the lungs, due to a specific micro-organism, the *micrococcus pneumoniæ*, which produces a potent poison, affecting the whole system and frequently causing death.

The Virulence of the Germ.— The virulence of the germ of pneumonia is subject to wide variations. In the bacteriological laboratory there are cultures one-millionth of a cubic centimeter of which will induce death in animals, while there are other cultures twenty times the above given amount of which are necessary to produce the same effect. As a rule; the virulence is increased when the germ passes directly from one person or one animal to another. This is one of the reasons why the disinfection of the sputum of the person suffering from pneumonia is so desirable.

Importance of Pneumonia as a Cause of Deaths.— Averaging the mortality statistics of Michigan, collected under the new law, for the six years, 1898-1903, the latest yet compiled by the State Department, the order of importance of the most dangerous communicable diseases, as causes of deaths, was as follows: Pneumonia, tuberculosis, meningitis, typhoid fever, diphtheria, whooping-cough, scarlet fever, measles, and small-pox. The relative importance of these diseases, in those years, is shown by the diagram.

*Leaflet of the Michigan State Board of Health.

DEATHS IN MICHIGAN 6 YEARS, 1898-1903.



During the ten years ending with 1897, the statistics collected under the old law showed that then the most dangerous communicable diseases, named in the order of their importance, were: Tuberculosis, pneumonia, diphtheria, typhoid fever, influenza, scarlet fever, meningitis, measles, whooping-cough and smallpox. It will be seen that pneumonia was then exceeded only by tuberculosis as a terrible death-dealing scourge. Tuberculosis has continued to decrease. Pneumonia has been rapidly replacing tuberculosis and is now the greatest single cause of deaths in Michigan

The Mode of Communication.— It is by means of sputa (all discharges from the lungs, throat, nose, and mouth) containing micro-organisms capable of producing pneumonia that this dangerous disease is usually spread.

Destruction of the Sputa.— It is evident that the most certain preventive of pneumonia is to destroy

the sputum from the patient before it has an opportunity to dry and scatter the germs of disease.

How the Sputa Should be Destroyed.— During the illness great care should be taken to prevent soiling bed clothing, carpets, or furniture with the sputa. The patient should cough into a moistened cloth and the cloth should be burned before allowing it to become dry. It is not a sufficient precaution to exercise this care during the patient's brief illness, because the germs causing pneumonia are capable of living for a considerable time in the mouth and nose of a person who has had the disease. Therefore, during convalescence, so long as any sputum is raised from the lungs, and for at least two or three weeks, all expectoration should be into a cup or cuspidor containing a disinfectant, the best disinfectant being a five per cent solution of carbolic acid — one ounce of carbolic acid dissolved in a pint and a half of water. If not confined to the house, it is best that the convalescent, and that all persons who have a cough, should carry small pieces of cloth (each just large enough to properly receive one sputum) and paraffined paper envelopes or wrappers in which the cloth, as soon as once used, may be put and securely enclosed, and, with its envelope, burned on the first opportunity. Remember that the sputum must not be allowed to become dry.

The Spitting Nuisance Dangerous to the Public Health.— It is now well known that the human saliva

is the natural habitat of many species of micro-organisms which gain access to the mouth in various ways, the most common being by breathing, through the mouth, air containing them. In a case of pneumonia, however, the germs of the disease are coughed up from the lungs. The sputum is, therefore, the common way by which pneumonia and some other dangerous communicable diseases are spread. After drying, the germs with which the sputum is charged mingle with the dust of rooms in homes, churches, schools, public halls, stores, and cars, In these places they are inhaled by human beings, with results dependent largely upon physical and meteorological conditions. The physical and meteorological conditions cannot always be avoided; therefore, success in the restriction of those diseases must lie in the direction of the destruction of the germs which produce those diseases. It is probable that, could the sputum always be destroyed as soon as ejected, pneumonia and a few other important diseases would soon disappear. We are confronted with the practical problem of how this may be done, either wholly or in a large degree. This problem is not an easy one to solve, for the reason that every man regards himself as independent and endowed with the inalienable right enjoyed by man throughout all ages, of depositing saliva wherever he chooses. Many municipalities are indeavoring to enforce regulations more or less stringent to prohibit spitting upon sidewalks and in other public places.

These efforts are largely due to the knowledge now becoming so common that the germs of tuberculosis are spread by the air containing the germs of this disease which have been ejected in the sputum of the victims of the disease. When it becomes generally understood that sputum may contain not only germs of tuberculosis, but also the germs of pneumonia and of other dangerous communicable diseases, the efforts that are now being put forth to prohibit this public and dangerous nuisance should be largely increased.

Legal measures can be used only against the person spitting in public places. The person who contaminates the air of his home with his saliva is largely beyond the reach of such measures. Public opinion is necessary to sustain the enforcement of any law. It is especially necsssary where it is sought to enforce a law depriving citizens of a privilege they have long enjoyed and can see no reason why they should not continue to possess. Education of the people concerning the importance of destroying or disinfecting all sputum must, therefore, precede forcible measures. This education should be such as to induce every intelligent person to destroy or disinfect the sputum or saliva he or she ejects, and to insist that the careless and the ignorant be compelled to do likewise. It is to be hoped that such education will result in the formation of public opinion, so that it will demand that the law shall not only reach the public spitter, but that it will also apply to the person who contaminates

his own home, thus not only endangering his own family, but also endangering the lives of all who may enter such a home. The press, the teachers in our public shcools, the preachers in our pulpits, and all others who in any degree mould public opinion should urge this most important sanitary reform.

Isolation of the Patient.—It is believed that if care is taken with all the discharges from the nose and mouth, isolation of the patient may not always be necessary, although it is undoubtedly wise for all who can do so, and especially all children, to keep away from the patient. And, pneumonia being an acute disease, of short duration, isolation may properly be practiced.

Ventilation of Buildings.—Through better systems of ventilation, much may be done for lessening the number of micro-organisms inhaled with the dust of floors, carpets, etc., especially by having the foul air exits at the floor level, so that the general motion of the foul air shall be downwards, and not upwards into the nostrils of the inmates of the room. This is especially important with reference to all public buildings, as, also, that they shall constantly have a liberal supply of fresh air.

Personal Precaution.—Any person dusting objects in a room, cleansing the floors, walls or ceiling of the living or sleeping room of a person suffering with pneumonia might well use a respirator. Several folds of gauze moistened and tied loosely over the

nose and mouth might be used. The sweeping and dusting of a room which has recently been occupied by a person sick with pneumonia should be deferred until after the room and contents have been subjected to the fumes of burning sulphur, or of formaldehyde.

No one should sleep in the same room with a patient, nor in a room which has been recently occupied by a person sick with pneumonia, unless the room (with all its contents) has been previously thoroughly disinfected.

It is best not to stand near a person who is coughing, because in coughing finely divided droplets of saliva are thrown from the mouth and may be carried for a distance of three feet. These droplets may contain large numbers of germs. They are also sometimes thrown out in forcible speaking. The ordinary breath does not contain them.

Much may be done to lessen the liability to contract pneumonia, by having the sanitary surroundings as nearly perfect as possible, and by keeping the lungs strong and healthy. These facts emphasize the importance of pure food, pure air, and healthful exercise.

Exposure to Cold Wind should be Avoided.—Statistics of sickness and of deaths, collated with meteorological statistics, prove that the colder months of the year and those following are the months during which pneumonia prevails most extensively, and during which it sometimes assumes an epidemic form. At

such times every person should avoid exposure to cold wind and to chill from a change from heavy to light clothing.

Disinfection.—Disinfection of rooms and contents can be complete only in the absence of living persons, as fumes strong enough for the purpose are destructive of human life. Curtains, draperies, carpets, clothing and all movable articles *should be exposed to sunlight in the open air.* The unwashed clothing of a person sick with pneumonia should not be mingled with the unwashed clothing of another person; care should be taken that the handkerchiefs be boiled, and other articles likely to harbor the germs be disinfected before sending them to the laundry.

After a death or recovery from pneumonia, the room in which there has been a case of this disease, and the furniture and other contents, should be thoroughly exposed for several hours to formaldehyde gas, or to fumes of burning sulphur, and then exposed for several hours to currents of fresh air. Hang up and spread out as much as possible all blankets and other articles to be disinfected; turn pockets inside out, and otherwise facilitate the access of the disinfecting fumes to all infected places. For a room ten feet square, at least eight ounces of a forty per cent solution of formaldehyde, or at least two ounces of solidified formaldehyde should be rapidly distilled into the room, or at least three pounds of sulphur should be rapidly burned; and for larger rooms proportionately

increased quantities should be used, at the rate of at least eight ounces of a forty per cent solution of formaldehyde, or at least two ounces of solidified formaldehyde, or three pounds of sulphur per each one thousand cubic feet of air-space. After fumigation, the walls may be whitewashed, albastined, painted, repapered, or rubbed with bread-crumbs, which should then be burned; the woodwork, including the floor, may be painted or thoroughly washed. If any sputum is deposited thereon, it should be washed with a five per cent solution of carbolic acid.

DIPHTHERIA*

Diphtheria is a dangerous communicable disease, caused by a specific contagium, the germ of which is propagated in the human body or its excretions, and spread *from person to person*, directly and indirectly. Until recent years, the supposition has prevailed that cases of diphtheria might arise *de novo* from a filthy condition of premises, backyards, privy vaults, cesspools, etc.; but later researches have made it plain that this notion is not a correct one. Filthy conditions may serve to harbor the germs, but they do not produce the germ. Rather, it seems to have been proved from statistics compiled in this department that at least four-fifths of the cases of diphtheria in Michigan come almost directly from a preceding case.

The *bacillus* which causes diphtheria does not gen-

*Bulletin of the Michigan State Board of Health.

erally enter the blood. The *poison* generated by the bacillus is absorbed into the body, and causes degenerations of muscular tissue, heart failure, paralysis, etc.; but the germ generally remains in its locality, usually in the throat. Therefore the spread of this disease is mainly from the throat and mouth. Everything touched by the mouth, or by the discharges from the mouth, throat or nose, may be infected.

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HOW TO AVOID AND PREVENT DIPTHERIA

Avoid the Special Contagium of the Disease.—This is especially important to be observed by children. Children under ten years of age are in much greater danger of death from diphtheria than are adults; but adult persons often get and spread the disease, and sometimes die from it. Mild cases in adults may cause fatal cases among children. Because of these facts it is frequently dangerous for children to go where adult persons go with almost perfect safety to themselves.

Do Not Let a Child Go Near a Case of Diphtheria.—Do not permit any person or thing, or a dog, cat, or other animal to come from a case of diphtheria to a child. No cat or dog should be permitted to enter the sick-room. Unless your services are needed, keep away from the disease yourself. If you do visit a case, bathe yourself and change and disinfect your clothing, hair, beard, if any, and hands, before you go where there is a child.

The contagium of diphtheria sometimes retains its virulence for a long time, and may be carried a long distance in articles in which it has found lodgment. Do not permit a child to enter a privy or water closet, or to breathe the air from a privy, water closet, cess-pool or sewer into which undisinfected discharges from persons sick with diphtheria have entered, nor to drink water or milk which has been exposed to such air.

Do not permit a child to ride in any closed carriage in which has been a person sick with diphtheria, except the carriage has since been thoroughly disinfected with fumes of burning sulphur.

Abrasions of the skin or mucous membrane favor the contraction of diphtheria. The disease spreads most at such seasons of the year as sore throats prevail. All influences which cause sore throats, such as exposure to wind and to breathing cold, dry air, probably tend to promote the taking and spreading of this disease.

Do not permit a child to wear or handle clothing worn by a person during sickness or convalescence from diphtheria.

Beware of any person who has a sore throat. Do not kiss or come near to such a person. Do not drink from the same cup, blow the same whistle, or put his pencil or pen in your mouth.

Beware of crowded assemblies in unventilated rooms.

Individual drinking cups should be used. A common drinking cup should not be used, especially in school-rooms and places where there is liability of infection. Diphtheria bacilli have been found on cups in actual common use in schools. A fountain cup would be less liable to spread disease, because the water continually overflows the sides and tends to wash away any infection which might otherwise collect on the edges of the cup.

Children believed to be uninfected may be sent away from the house in which there is diphtheria, to families in which there are no persons liable to the disease, or to previously disinfected convalescent wards in hospitals; but in either case they should be isolated from the public until the expiration of the period of incubation, that is, the interval of time between exposure to the contagium of diphtheria and the first sign of the disease in the person so exposed. This time may vary. In many cases it may appear in seven days, in some cases twelve days or more; the average period is about seven or eight days, but for full protection to the public isolation should be observed for two weeks, at least.

Exposed persons should be isolated until this time has elapsed.

The administration of antitoxic serum, by physicians, has been found to be safe and quite effective as a preventive measure, especially in children; and when circumstances are such that they must remain

in the same house with a person sick with diphtheria, the antoxin is so very important that it cannot properly be neglected. But even where the antitoxin is administered, isolation of a person exposed to diphtheria is advised, to prevent the spread of the disease.

Where Diphtheria Is Present in a Community.—When a child or a young person has a sore throat, bad odor to its breath, especially if it has fever, it should immediately be kept separated from all other persons, except necessary attendants, until it be ascertained whether or not it has diphtheria or some other communicable disease.

Persons who are attending upon children or other persons suffering from diphtheria, and also the members of the patient's family, should not mingle with other people nor permit the entrance of children into their house.

SANITARY CARE OF INFECTED AND SICK PERSONS AND ROOMS

Membranous Croup.—Modern researches point to a probable common origin of diphtheria and membranous or inflammatory croup, differing only in location from true diphtheria; therefore, membranous or inflammatory croup should be recognized as a communicable disease dangerous to the public health, and should be reported, and isolation and disinfection should be enforced the same as in other cases of diphtheria.

In all cases of sore throat, precaution should be

taken. It is often difficult to distinguish mild cases of diphtheria from a simple tonsillitis, pharyngitis, or laryngitis, and such mild cases of diphtheria often communicate a dangerous and fatal form of diphtheria; therefore, it is the duty of physicians and householders in reporting diseases dangerous to the public health, and of local health authorities in their efforts to restrict such diseases, in every case, to give to the public safety the benefit of the doubt, and in localities where diphtheria exists to regard cases of acute sore throat as suspected cases of diphtheria.

Bacteriological Tests.—No health officer should fail to act for the restriction of diphtheria in any case of sore throat in which there is doubt, certainly not until bacteriological tests have indicated the absence of Löffler bacillus (now known to be the specific cause of true diptheria). Such tests will be made at cost by the "State Laboratory of Hygiene, Ann Arbor, Michigan." Disease germs cannot lawfully be sent by mail, except in special mailing cases.

Every person known to be sick with diphtheria should be promptly and thoroughly isolated from the public.

In ordering the isolation of infected or exposed persons, the health officer means that their communication with well persons, and the removal of any article from the infected room or premises, shall be absolutely cut off, unless such communication is carried on only under his supervision. Except it be disin-

fected, no letter or paper should be sent through the mail from an infected place.

That this is of more importance than in the case of small-pox is indicated by the fact of the much greater number of cases of sickness and of deaths from diphtheria.

The room in which one sick with this disease is to be placed should previously be cleared of all needless clothing, drapery, and other materials likely to harbor the germs of the disease; and, except after thorough disinfection, nothing already exposed to the contagium of the disease should be moved from the room. The sick-room should have only such articles as are indispensable to the well-being of the patient, and should have no carpet, or only pieces which can afterwards be destroyed. Provision should be made for the introduction of a liberal supply of fresh air and the continual change of the air in the room without sensible currents or drafts.

Handkerchiefs, that need to be saved, should not be used by the patient; small pieces of rag should be substituted therefor, and after being once used should be immediately burned.

Soiled clothing, towels, bed-linen, etc., on removal from the patient, should not be carried about while dry, but should be placed in a pail or tub and covered with a two per cent solution of carbolic acid Soiled clothing should, in all cases, be disinfected before sending away to a laundry, either by boiling for at

least half an hour, or by soaking in a two per cent solution of carbolic acid.

The discharges from the throat, mouth, and from the kidneys and bowels of the patient should be received into vessels containing an equal volume of a five per cent solution of carbolic acid, and in cities where sewers are used, thrown into the water closet; elsewhere the same should be buried at least 100 feet distant from any well, and should not by any means be thrown into a running stream, nor into a cesspool or privy, except after having been thoroughly disinfected. Discharges from the nose, bladder, and bowels may be received on old cloths, which should be immediately burned. All vessels should be kept scrupulously clean and disinfected.

All cups, glasses, spoons, etc., used in the sick-room should at once on removal from the room be washed in the disinfecting solution mentioned above, and afterwards in hot water, before being used by any other person.

Food and drink that have been in a sick-room, or otherwise infected with diptheria, should be destroyed or burned. They should not be put in the swill barrel.

Perfect cleanliness of nurses and attendants should be enjoined and secured. As the hands of nurses of necessity become frequently contaminated by the contagium of the disease, a good supply of towels and basins,—one containing a two per cent solution of car-

bolic acid, and another for plain soap and water,—should always be at hand and freely used.

All persons recovering, or very recently recovered, from diphtheria should be considered dangerous; therefore, such a person should not be permitted to associate with others, or to attend school, church, or any public assembly until the throat and any sores which may have been on the lips or nose are healed, nor until, in the judgment of a careful and intelligent health officer, he can do so without endangering others. The bacillus which is the specific cause of diphtheria has been found in the throat weeks after apparent complete recovery from the disease.

In a house infected with diphtheria, a temporary disinfection after apparent recovery may be made, so as to release from isolation the members of the household who have not had the disease, but those released should be kept under surveillance by the health officer for seven or eight days. After the period of infectiousness has passed, a final disinfection of the room occupied by the convalescent should be made.

Disinfection is Necessary—Diphtheria bacilli in a comparatively dry state remain capable of renewed activity for at least four or five months. Therefore dust derived from the discharges from the throat, mouth, or nose may cause the disease months after the bacilli have left the throat in which they were propagated. This is the reason why disinfection is necessary.

FINAL PRECAUTIONS

After a death or recovery from diphtheria, the law requires that thorough disinfection of the infected person and premises be made before releasing the person from isolation, and that the local board provide for a temporary shelter during disinfection. Disinfection of a room always necessitates vacating it, and sometimes makes it impossible to remain in adjoining rooms; therefore, in some cases it seems essential to have hospital, tent, or temporary shelter for the inmates of infected houses, where bathing, disinfection and washing can be done while such houses are being disinfected and put in order.

Disinfection of the person, after recovery, consists of a thorough washing with soap and water of the person, hair, and beard, if any. Under the direction of a physician an antiseptic bath may be employed; but antiseptics are, as a rule, poisons to be carefully used as directed by a physician. A common antiseptic is bichloride of mercury (corrosive sublimate), one part to one thousand parts of water.

All infected articles, including the clothing worn by the patient during recovery, should immediately be destroyed or disinfected in a way so careful and complete that the contagium have no opportunity to spread the disease in the process. Articles of small value, or which cannot be properly disinfected, should be burned by a quick, strong fire.

Thorough disinfection should be made of the sick-

room, its contents, and all articles handled by the convalescing patient. Germs have been known to remain for a long time in the clothing, especially if woolen, and packed away in drawers or trunks; and books and furs that have been used or handled by those convalescing from this disease are particularly liable to convey the poison to children who have never had the disease. Therefore, great care should be taken to spread out as much as possible all clothing, turning the pockets inside out; to expose as great a surface as possible of the bedding to the disinfectant. Cotton, linen, flannels, blankets, etc., should be treated with the boiling-hot water, introducing them piece by piece, securing thorough wetting and boiling for at least half an hour. Heavy woolen clothing, silks, furs, stuffed bed covers, beds and other articles which cannot be boiled, should be hung in the room during fumigation, pockets being turned inside out and the whole garment being thoroughly exposed. Afterward, they should be hung in the open air, beaten and shaken. Carpets are best fumigated on the floor, but should afterward be removed to the open air and thoroughly beaten. Pillows, beds, stuffed mattresses, upholstered furniture, etc., after being disinfected on the outside, may be cut open and their contents again exposed to fumes of burning sulphur. In no cases should the thorough disinfection of clothing, bedding, etc., be omitted. Infected clothing and bedding have been known to communicate diphtheria months after

their infection. As diphtheria germs have been known to find lodgment in wall-paper and remain active for months, all paper should be removed from the walls of a room occupied by a diphtheria case, before disinfecting said room. After disinfection the woodwork should be washed with a 1-1000 solution of corrosive sublimate, or a two per cent solution of carbolic acid; or better still, painted over with a coat of paint.

Rooms should be disinfected either with sulphur or formaldehyde. For each thousand cubic feet of air space to be disinfected, three pounds of sulphur should be burned. Thus for a room about ten feet square, three pounds of sulphur should be used. The best results are obtained by using roll brimstone broken up, or flowers of sulphur, burning the sulphur in shallow pans of sufficient number and size to rapidly fill the room with the fumes, and having quantities sufficient to last for several hours. Experience of the health officers in Michigan seems to have demonstrated that, in the ordinary homes of the people, in the manner above mentioned, and *without the presence of the vapor of water*, the specific cause of diphtheria is rendered incapable of causing diphtheria. This is a very important fact, because it enables us to disinfect rooms without the destruction of much property which would be entirely ruined if the vapor of water were present. The combustion of sulphur should be rapid, and continue a considerable time. Care should be taken to secure the complete burning of as much

of the sulphur as possible. To avoid danger of fire the iron pot or pan in which the sulphur is to be burned should be free from leaks, and should be placed over water in a tub or pan.

If formaldehyde is used, at least eight ounces of a forty per cent solution, or not less than two ounces of the solidified formaldehyde should be used and vaporized, for each thousand cubic feet of air-space to be disinfected. After disinfection, the room and contents should be exposed for several hours, or days, if practicable, to currents of fresh air and sunshine.

TYPHOID FEVER*

Typhoid fever is a communicable disease of protracted duration and found in all countries and under all conditions of climate. It is one of the preventable diseases, and sanitarians and physicians very generally agree that there is no cause for its existence in any community. This opinion is based upon a thorough knowledge of the nature and character of the disease, the well understood methods of infection and the further fact that it is often directly and positively controlled by modern measures. Notwithstanding this, there are between 350,000 and 400,000 cases of this disease with 35,000 deaths every year in the United States. Its widespread prevalence is due largely to public ignorance or indifference to the measures which can and should be taken to prevent it.

*Sanitary Bulletin, October, 1906, New Hampshire State Board of Health.

While no age is exempt from the disease, the most susceptible period is between the ages of 20 and 30. After 30 years of age, there is a decrease of liability of infection up to 70 years of age, when it again increases to the extreme limit of life.

Typhoid fever, although it exists at all seasons of the year, is more prevalent in the autumn months. Its greatest fatality is in September and October. The reason why typhoid fever should be more fatal in autumn than in any other period of the year is not well understood. Many theories have been advanced and some of the older ones abandoned. It is generally thought that the summer heat and dryness are in some way responsible to a greater or less degree for the increased prevalence of this disease in autumn. It is probable that the cold weather following has a restrictive effect, so that upon its advent the disease rapidly diminishes.

THE CAUSE OF TYPHOID FEVER.

Typhoid fever is a germ disease — that is, it is produced hy a micro-organism, known as the typhoid bacillus. The growth and development of this germ take place within the body of the typhoid patient. It is always found in great abundance in the discharges of a person having typhoid fever, from the time of infection to weeks after convalescence is established.

This germ always maintains its specific character,

and when it finds its way into the body of a person who is susceptible, the disease is developed in some form between that of a so-called walking case, slightly indisposed, to the most malignant, fatal type.

Formerly it was believed that typhoid fever was developed from general bad sanitary conditions, but this view is no longer entertained, the fact being that the seed must be sown, or, in other words, the particular germ of the disease must be taken into the system before a true case of typhoid fever can be established, and this germ comes from some prior case. A further consideration of the subject will show the various ways in which this may happen.

HOW TYPHOID FEVER IS SPREAD.

The most frequent medium for the spread of typhoid fever is a *polluted water supply*, and it is to this source that substantially all of the great epidemics of typhoid fever have been traced. From a like source, also, spring a great number of individual cases, frequently classed as "sporadic," the water being contaminated from sewers, house drains, privy vaults, and other sources through which the typhoid fever germ may be transmitted. A water supply, whether well, stream, reservoir, or pond, that is polluted with human excreta, solid or fluid, is a dangerous supply, because of the liability of typhoid infection at any moment. It is therefore highly essential that all water supplies, both private

and public, should be guarded against pollution of this kind.

Another source of typhoid fever is an *infected milk supply*. Outbreaks of the disease have occasionally appeared from this cause. Milk infection may take place through the addition of polluted water, or by washing the cans and other utensils with such water, or by the carelessness of milkers or others who handle the milk, whose hands or clothing may be infected.

No milk should be distributed from a farm or dairy where there is a case of typhoid fever.

Personal contact has been shown, by the commission appointed to investigate the spread of typhoid fever in the military camps during the Spanish War, to be a factor in the spread of this disease heretofore only partially recognized. In other words, the evidence shows that the disease was transmitted by persons not having the disease, infected bedding, clothing, eating and other utensils, and this to an extent that suggests the importance of most thorough disinfection of persons and things having any relation to a typhoid fever patient.

Flies are also carriers of contagion. Food may be infected through their agency. Oysters and other shell-fish that came from sewage-polluted waters and were eaten uncooked have transmitted this disease in numerous instances. Typhoid infection has undoubtedly been occasionally spread through vegetables grown upon infected soil and eaten raw. Infection from such a source is possible.

HOW TYPHOID GERMS ARE SCATTERED

The media through which typhoid germs leave the body are the fecal discharges and the urine. The expectorations in some cases of pneumonia (typhoid-pneumonia, so called) also contain them. In all cases where complete and constant disinfection is not practised the organisms of this disease are often so disposed of as to endanger the water and milk supplies, and other food products.

The so-called sporadic cases (individual cases, that cannot be directly connected with a prior case,) may readily be accounted for when the various ways in which the infection is distributed are understood.

An interval of 10 or 12 days takes place between the inception of the germ and the development of the characteristic symptoms, during which time the patient is daily excreting the germs of the disease in countless thousands. During this period of incubation the patient is unknowingly scattering the infection, wherever he may be.

There are also mild cases in which the patient is under no restraint, and travels about as usual. Such a case continues often for weeks, and, with no precautions taken, may cause a wide distribution of the germs of the disease.

A third way in which the poison of typhoid is extensively distributed is by patients who have so far recovered from the disease as to be able to travel about, or to assume their ordinary vocation,

it having been demonstrated that the germ in many cases is present in the urine for weeks, and in some cases for months, after convalescence is established. It will, therefore, be seen that the typhoid fever germ is doubtless very widely scattered, and when this fact is understood, it does not require a great stretch of the imagination to account for individual, or so-called sporadic, cases.

These facts, thoroughly established by scientific investigations, emphasize the great importance of enforcing disinfection in the sick-room constantly and to the minutest details and, further, of educating the patient that unless intelligent and effective precautions are taken he may be a source of danger to the community for some time after recovery.

The typhoid germ is nearly always taken into the system with food or drink, especially with water, and multiplies enormously in the intestinal canal. It is cast out of the body in the stools and in the urine, and probably by no other channel. This is of the utmost importance in considering measures to prevent the disease. As stated above, this germ, or plant organism, can live for some time after it leaves the body, just how long we do not know. In polluted soil, that is, earth containing much vegetable and animal matter undergoing decomposition, it may remain alive for several months, and possibly longer. Many soils possess excellent filtering properties, and remove practically all germs from water passing through

them. Other soils fail to filter out these germs. A well with a privy in close proximity is always more or less dangerous, and many outbreaks of typhoid fever have been traced to this condition. The germs of typhoid fever may get into the well at its top. In a hilly or rolling country it is not uncommon to find the privy on higher ground than the well. The privy often has no vault, the stools and urine being deposited on the surface of the ground. If the stools or urine of a typhoid patient are thrown into the privy, the first rain-storm may wash the germs of the disease into the well. The roots of trees growing into a well may serve as conductors for contaminating substances. A leaky drain near the well may pollute it.

It is only since a few years that we have known that the germs of typhoid fever are often present in the urine of a person suffering from that disease. Formerly they were thought to be in stools, so that while the stools were carefully disinfected, and possibly buried at a distance from the well, no attention was paid to the urine. The night vessel containing nothing but urine was often emptied near the well, where it was washed. *We must now consider that the urine, from its liquid character, is even more dangerous than the stools.*

CARE OF A CASE

A typhoid fever patient should be placed in a large,

airy room without a carpet or unnecessary furnishings. If there is diarrhœa, it is well to protect the bed with a rubber sheet, placed under the linen sheet. The most scrupulous care should be taken of the discharges from the bowels and bladder. The stools or urine should be received in a vessel containing milk of lime, prepared by freshly slaking lime, using one part of the resulting powder or creamy liquid to four parts of water. Use a liberal quantity, and mix thoroughly by stirring with a stick. Fresh chloride of lime (it should smell strongly of chlorine), eight ounces to the gallon, may be used instead, or carbolic acid, seven ounces to the gallon. The contents of the vessel may then be thrown into the water closet or buried far from any well or spring.

If the body linen or bed clothing should be soiled with the patient's discharges, they should be at once removed and placed in the carbolic acid solution; or, if the odor is objected to, in a solution of corrosive sublimate, a drachm to a gallon of water. After soaking an hour or more, they may be laundered, as usual. There is no disinfectant for clothing better than boiling water, and if soiled clothing can be promptly boiled this is the best treatment.

The nurse should be exceeding careful about disinfecting her hands immediately after handling the patient. The carbolic acid or corrosive sublimate solution will be suitable for this purpose, or Labarraque's solution, one pint to a gallon of water, is

efficient and pleasant. She should never eat or drink in the sick-room. As spoons, dishes, etc., used in the sick-room may become infected, it is well to disinfect these by boiling them in water for half an hour before they are used again.

The disinfection of stools, clothing, etc., should be kept up until the patient has fully recovered. While it is not necessary to strictly isolate the patient, no needless visits to the sick-room should be allowed.

In all outbreaks of typhoid fever of any considerable extent, there are, as a rule, many doubtful cases; persons who have fever for some days, and possibly bowel symptoms, but who are not confined to the house. These cases should be dealt with as typhoid fever and taken care of, to secure efficient disinfection.

Allow no flies to have access to sputum or discharges from the bowels and bladder, infected with typhoid fever. The disease is liable to be spread by flies, which go from infected excreta to bread, cake, and other food to be eaten uncooked.

QUARANTINE UNNECESSARY

It is entirely unnecessary to quarantine a case of typhoid fever, or the premises in which it exists, provided proper care is given to all the details of the sick-room, as recommended.

The use of placards has been largely discontinued in this disease, and is not now required in this state.

If disinfection is practiced as strictly as it should

be, there is no danger of the disease's being communicated to others from a given case; but constant cleanliness and disinfection are absolutely necessary to secure such result.

DISINFECTANTS

For daily use in connection with a case of typhoid fever there are no better disinfectants than chloride of lime, and the milk of lime, formulas for which are given below. The milk of lime has the decided advantage of not having an objectionable odor.

At the proper time, general disinfection of the sick-room should be carried out by the local board of health, using the formaldehyde process already recommended for this purpose.

CHLORIDE OF LIME SOLUTION

Chloride of lime (bleaching powder), one pound; water, three gallons. Mix. Cost, about three cents per gallon.

Care should be taken to obtain *fresh* chloride of lime.

This solution is so cheap that it can be used with great freedom, and it is one of the best disinfectants known. A quart or more per day may be used in an offensive vault, and such quantities as may be necessary in other places. It may be used in a sprinkler in stables and elsewhere. In the sick-room it may be used in vessels, cuspidors, etc. Sheets and other clothing used by the patient may be immersed in a

pail or tub of this solution, diluted (one gallon of solution to ten of water), for two hours, or till ready for the wash-room or laundry. This solution is non-poisonous and does not injure white clothing.

It may also be used for washing the hands or other parts of the body which may have been exposed to infection from excreta, etc.

For a free and general use in privy vaults, sewers, sink-drains, refuse heaps, stables, and wherever else the odor of the disinfectant is not objectionable, this is one of the cheapest and most effective disinfectants and germicides available for general use. It should be used so freely as to *wet* everything required to be disinfected. Its *odor* does not disinfect—only covers up other odors.

MILK OF LIME (QUICKLIME)

Slake a quart of freshly burnt lime (in small pieces) with three fourths of a quart of water — or, to be exact, 60 parts of water by weight with 100 of lime. A dry powder of slaked lime (hydrate of lime) results. Make milk of lime not long before it is to be used by mixing one part of this dry hydrate of lime with eight parts (by weight) of water.

Air-slaked lime is worthless. The dry hydrate may be preserved some time if it is enclosed in an air-tight container. Milk of lime should be freshly prepared, but may be kept a few days if it is closely stoppered.

Quicklime is one of the cheapest of disinfectants. This solution can take the place of chloride of lime, if desired. It should be used freely, in quantity equal in amount to the material to be disinfected. It can be used to whitewash exposed surfaces, to disinfect excreta in the sick-room or on the surface of the ground, in sinks, drains, stagnant pools, etc.

Much of the so-called disinfection practiced in families is wholly inefficient and useless. The burning of coffee, tar, sulphur, or other substance in the sick-room or in any other part of the house or premises in the presence of the patient or other persons, operates, at most, only as a deodorizer, and does not destroy the germs of the disease.

It should also be known that many of the preparations offered for sale as disinfectants, germ killers, etc., are worthless, or nearly so, and should never be relied upon.

Reliable formulas are given by which a family may make disinfectant solutions possessing the required strength and efficiency, and at a much less cost than is asked for proprietary preparations.

"In olden days, no crime was so atrocious as that of poisoning wells, and even in times of war, the moral sense of those heathen nations was sufficient to prevent such a convenient way of destroying a nation's enemies. But in these days, one city poisons another's water supply without the least

hesitation and with little or no protest except from the State Department of Health."—*Monthly Bulletin, New York State Board of Health.*

"The time is not far distant when an epidenic of typhoid fever in any commonwealth will be just grievance for damage against the municipality allowing its existence. The water and milk supply are the great sources of infection, and by adopting proper sanitary and hygienic measures along these lines typhoid fever can be wiped out."—*Wisconsin State Board of Health Bulletin.*

FORMALDEHYDE DISINFECTION — A NEW PROCESS*

A long series of experiments in the Laboratory of Hygiene have developed the fact that formaldehyde may successfully and very conveniently be used in the disinfection of the rooms with the use of no lamps, generators, or other special apparatus whatever. In the process which has been employed in this work, formaldehyde gas is liberated by pouring formaldehyde upon permanganate of potassium. At ordinary room temperatures a chemical reaction results whereby a high degree of heat is evolved. This heat causes an effervescence or boiling, and formaldehyde gas is given off very rapidly.

The advantages of this method are, that the disinfecter need not transport apparatus from place to place; that there is no generator or lamp which might originate a fire; that almost the whole quantity of formaldehyde available for disinfection is liberated in a few moments, thus giving the maximum concentration of the gas before there has been time for leakage of the part first evolved; that, through the action of the heat liberated by the chemical reaction, a sufficient quantity of steam goes off wih the formaldehyde to insure efficient disinfection.

In carrying out this process of disinfection the

*Circular No. 75, State Board of Health of Maine.

requisites are simply the ordinary so-called 40 per cent formaldehyde solution, commercial permanganate of potassium, and a vessel to mix them in.

The required quantity of permanganate for each pint of formaldehyde is 7½ ounces. The permanganate is first put into the dish and the formaldehyde is then poured upon it. *The permanganate must go in first.* Before the mixture is made everything must be in readiness, because a rapid flight from the room must be made. Leave the room closed up tightly four hours.

The vessel in which the permanganate and formaldehyde are to be mixed should be of considerable size, else the vigorous foaming will throw a part of the mixture upon the floor. A flaring ten-quart tin pail is a suitable and large enough vessel unless more than three pints of formaldehyde are to be used, and even then until the disinfecter is well acquainted with this process, it would be a safe precaution to set the pail inside of a large pan. In this, as in all methods of chemical disinfection, the disinfectant action is more efficient the warmer the room.

As it is necessary to adjust carefully the relative quantities of permanganate and formaldehyde, and as it is much more convenient to measure the permanganate than to weigh it, arrangements have been made with some of the druggists to keep in stock a small tin measure holding 3¾ ounces of permanganate, "strick" measure, not shaken down.

The rule is, in ordinary disinfection: for each 1000 cubic feet of room space to be disinfected, two measurefuls of permanganate and one pint measureful of formaldehyde.

A large quantity of formaldehyde and a shortened time of exposure are more efficient and generally more economical than a smaller quantity of formaldehyde and a lengthened period of exposure. It is a saving to families that have to submit to disinfection to have the time shortened, and is much more satisfactory to them. With the time at four hours, formaldehyde fumigation may be completed in the forenoon and the rooms may have a lengthened airing in the afternooon so the family may occupy their rooms the same evening The state board of health now makes the following recommendations:

1. In ordinary disinfection, when the infection to be destroyed is that of typhoid fever, diphtheria, scarlet fever, small-pox, measles, grippe, whooping-cough, dysentery or cholera, use one pint of formaldehyde for each 1000 cubic feet of space to be disinfected. Though a considerably smaller quantity was found efficient in the experimental work, allowance must be made for unusual leakage from rooms, for low temperature, for insufficient moisture, for inaccessibility of parts of the infection, etc. It is necessary to have quite a wide margin for safety, but the quantities herein advised provide for that margin if the work is intelligently done.

2. When the infection to be destroyed is the more resistant micro-organisms of tuberculosis, or of specticemia, a pint and a half of formaldehyde (formalin) per 1000 cubic feet of space should be used. The same quantity at least should be used in the disinfection of books, clothing, and in all cases in which the infection is not entirely open and accessible to the gas, that is, when some degree of penetration must be secured.

The experiments have shown that, used as is herein recommended, formaldehyde gas has some considerable power of penetration; nevertheless, the state board of health does not yet deem it safe to advise any marked departure from the general method of disinfection given in its circulars on the infectious diseases — scrubbing up of floors, boiling the cotton and linen clothing of the patient and of his bed and such other badly infected articles as can thus be treated, or soaking them in a disinfecting solution.

SUPPLEMENTAL PROGRAM ARRANGED FOR CLASS STUDY ON

HOME CARE FOR THE SICK

MEETING I

(Study pages 1–13)

Symptoms of Disease

See *Care of Children*, pages 153–159, for children's diseases. (Vol. XI of the Library of Home Economics.)

The Sick-Room.

See *Household Hygiene*, Ventilation and Heating, Home Nursing, Harrison, pages 1–13. ($1.00, postage 10c.)

MEETING II

(Study pages 13–34)

Care of the Patient

Make bed with draw-sheet, as described in the text.
Change the bed as described.
Lift patient to sitting position.
Make back rest and foot brace.
Change patient from one bed to another, two methods.
Change mattress with patient in bed.
Make a wadding ring to relieve pressure.
If possible, get a trained nurse to show how these things are done.

Convalescence

Lift patient into a chair.
Topic—Amusing the convalescent and sick children.

MEETING III

(Study pages 34–62.)

Baths and Bathing

Make up pitcher of water, cool, tepid, warm, etc., of the various degrees of temperature given on page 41.

Test with a bath or other thermometer and with the hand. Note how unreliable the hand may be; after the hand has been in the cold water, the tepid water feels warm, and after having been in the hot water, the tepid water feels cold.

Home Nursing, Harrison, pages 63–73. ($1.00, postage 10c.

Practical Points in Nursing, Emily Stoney, pages 83-93 ($1.75, postage 20c.)

Temperature, Pulse, Giving Medicine, etc.

Obtain a clinical thermometer and take temperature a number of times, having all read the thermometer to 1-10 of a degree, and write the reading on slips of paper. Compare results. If there is any difficulty in shaking down the mercury, get a physician or nurse to show how it is done. A clinical thermometer may be purchased through the School for $1.25, or will be loaned for 10c.

Count the pulse in quarters for a second, as described, and compare results as in the taking of temperature.

Count the respiration, as directed.

Have an exhibit of medicine glasses, feeding cups, syringes, ice-caps.

Make poultices, sinapisms, flannel for fomentations, compresses.

(Select answers to the Test Questions on Part I and send to the School. Report on Meetings I, II, and III.)

MEETING IV

(Study pages 63–73)

Contagious Diseases: Disinfection

See article in the supplement, also send for and read some of the following Bulletins issued by State Boards of Health:

Lansing, Michigan, "Dangerous Communicable Diseases."

Concord, New Hampshire, "Consumption."

Springfield, Illinois, "Consumption" also "Practical Disinfection."

Augusta, Maine, "Contagious Diseases."

Trenton, New Jersey, "Restriction of the Spread of Infectious Diseases."

These Bulletins are sent free, or for a 2c stamp. Send to your own State Board of Health, if not included in the above; to your capital city, for any Bulletins.

MEETING V

(Study pages 73–105)

Surgical Work: Obstetrics

Practical Points in Nursing, Stoney, ($1.75, postage 20c.)

Food for the Sick

Food and Cookery for the Sick and Convalescent. ($1.50, postage 18c.)

Food for the Sick, French, ($1.00, postage 10c.)

Hand Book of Invalid Cookery, Boland, ($2.00, postage 16c.

Collect appropriate recipes in addition to those given in the text.

Show dainty and suitable serving for the sick.

MEETING VI

(Study pages 105–121)

Emergencies

Practice artificial respiration, as described.

Make a tourniquet.

Bandaging and Bandages

Practice all the bandages described. If possible, get a trained nurse to show methods.

(Select answers to the Test Questions on Part II and report on Meetings IV, V, and VI.)

INDEX

Purpose of the Course

TO make housekeeping an inspiring profession, instead of deadening drudgery.

TO make the daily work in the home of fascinating interest instead of monotonous labor.

TO make housekeeping easier and simpler by utilizing modern science in the home.

TO make the household money go further, that the higher things of life may be included.

TO preserve and increase health, and thereby promote happiness and prosperity.

TO develop the children—mentally, morally and physically—to their finest possibilities.

TO effect the conservation and improvement of the American home.

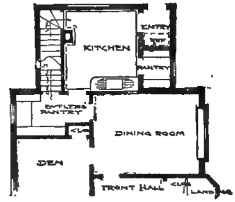
TO raise ideals of American home-making.

—*American School of Home Economics.*

THE LIBRARY OF

PARTIAL SYNOPSIS

Vol. I. **THE HOUSE: ITS PLAN, DECORATION AND CARE, by Prof. Isabel Bevier**, University of Illinois.

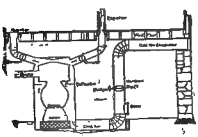


Treats of the development of the modern home and the American house, the planning of convenient houses, construction, floors; the problems of decoration and furnishing; gives suggestions for changes, repairs, household conveniences, "The Cost of Building," etc.

Vol. II. HOUSEHOLD BACTERIOLOGY, by **S. Maria Elliott**, Simmons College, Boston.

An interesting account of the microscopic forms of life and their relation for good and evil to the household; what dust is and how to make "dust gardens"; disease germs and how to avoid them; the protectin gagencies of the body and how to keep them active; sanitation, etc.

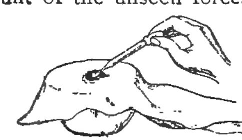
Vol. III. HOUSEHOLD HYGIENE, by S. Maria **Elliott**, Simmons College.



The healthful home; the best situation for the house; importance of the cellar; all about drainage, heating, lighting, disposal of wastes, plumbing tests, the water supply; practical suggestions for sanitary furnishings and care; hygenic housekeeping, etc.

Vol. IV. CHEMISTRY OF THE HOUSEHOLD, by **Margaret E. Dodd**, S. B., Mass. Institute of Technology.

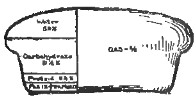
"A Day's Chemistry"—a fascinating account of the unseen forces in the common things met in a day's work—water, air, fire, fuel; chemistry of food, of digestion, of cookery, of baking powder, of cleaning, of laundry, of stains, of lighting; home tests; home-made baking powder, soap, etc., etc.



Vol. V. PRINCIPLES OF COOKERY, by **Anna Barrows**, Columbia University and Chautauqua School of Cookery.

"A key to the cook books"—analyzing and explaining the principles on which success rests; all approved methods of cookery explained particular attention being paid to economy of time and materials; full consideration of menus, making a fireless cook-stove, "Directions for Waitresses," etc.

Vol. VI. FOOD AND DIETETICS, by **Prof. Alice P. Norton**, University of Chicago.



Tells of the composition, nutritive value and digestibility of foods; how the body makes use of food; food economy; the balanced ration; healthful diet for the sedentary, the aged, the children, and so on; food adulterations, etc.

COMMENDATION ON THE COURSE IN BOOK FORM:

THE OUTLOOK

"It is true that the management of the home and the care of the family may now rightly be called both a business and a profession. Looking at the subject in this light, the volumes of this library may be regarded as the tools and formulae for carrying on the work in a systematized and intelligent manner. * * * A wise discrimination has been exercised in the choice of the authors of the lessons, for these writers are recognized authorities and special students in the various fields with which they deal. In all cases, simplicity of statement and clarity * * * brevity without sacrificing completeness, are qualities carefully sought for."

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Part IV. DECEMBER MENUS: Candy Making, Classes, Methods, and Recipes: *Christmas Dinner* Menu, Recipes, Table Decoration and Serving; Cost of Food and Food Value; Suggestions for Reducing the Cost of the Food Served.

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